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Note on Hyblœa puera.

By R.S. HOLE, F.C.H., F.E.S.

1. IN Part No. 2 of his *Departmental Notes on Insects that affect Forestry* Mr. Stebbing has given the life-history of *Hyblœa puera* so far as it is possible, with the observations which, up to date, have been recorded regarding it. The following note has been compiled from observations made by me in 1901, in the Jubbulpore district of the Central Provinces, and as it throws additional light on a few doubtful points, it will, I trust, prove interesting. The observations are unfortunately not complete; but as owing to my recent transfer it is improbable that I shall be able to supplement or correct them for some time to come, I venture to put them forward as they are.

DESCRIPTION.

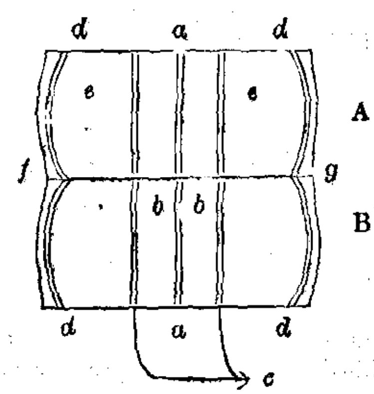
2. *Moth.*—The type is described on p. 371, Vol. II of *Hampson's Moths*, and no repetition of this description is needed here. It is, however, necessary to note that the colouring and markings vary considerably in different specimens, and in many cases depart widely from those of the type. From a number of moths collected by me I selected eleven which showed the most striking departures from the characters of the type, and sent them to Mr. de Nicéville for opinion, pointing out that in several cases the colouring and markings approached those of *Hyblœa constellata.* Mr. de Nicéville identified all these specimens as *Hyblœa puera*, remarking that "the species is obviously a very variable one." In many cases the ground colour of the thorax and forewing above is ashy grey, whereas in the type it is greyish red-brown. The forewing has frequently more or less extensive greenish or yellowish-white diffused patches on the upper side, which are triangular in shape when the wings are closed. These patches are absent in the type. On the under side, the costa and apex of the forewing and the whole of the hind wing, as well as the abdomen below and at the sides, are sometimes suffused with crimson. This is not seen in the type. The normal wing expanse is from 1·26 to 1·57 inches, but abnormally small specimens are

occasionally met with, the larvæ, apparently, having pupated before reaching their full development. One such seen by me had a wing expanse of only 1·02 inches.

3. *Pupa.*—Stout; colour bright brown to very dark purplish brown or black, with a few light scattered bristles. Short obtuse tail, furnished at the extremity with a hook, like a minute grapnel, with several flukes or claws. Length and mid-diameter of pupa in inches 0·74 and 0·21 respectively.

4. *Larva.*—On leaving the egg the larva is pale reddish or greenish-yellow in colour, with a black head and dorsal black mark on the first somite. It is then $\frac{1}{12}$th of an inch long and is active from the first. The colour of the dorsal surface gradually darkens and becomes greyish-green, the under surface being paler, the head and dorsal band on the first somite being jet black. When about a week old a change of skin takes place, after which the appearance of the larva entirely changes, the colouring being now practically that of the mature larva, which remains but little changed until the end of the larval existence. The general colour is now dark purple-grey to black above and bright yellow to greyish-green below. In *Hampson's Moths* the larva taken as the type is described as follows: "With a few short hairs; dark purple-grey above, olive-green below, with dorsal and lateral white lines; a sub-dorsal series of minute white dots and rings, a series of black dots on lateral line; head and first somite black."

Just as in the case of the moth so in the case of the larva, the colouring of different specimens varies greatly, and the principal variations are, in the case of the larva, found on the dorsal surface. In the larva which Hampson has apparently adopted as the type, a narrow pale and indistinct line will usually be found running along the middle of the back. On each side of this central line there is a clear white dorsal line, and below each of these dorsal lines there is a clear white lateral line running along each side of the larva just above the junction of the upper grey and lower yellow colour.



The above is a rough diagram of two adjacent segments of the larva seen from above, and enlarged, indicating the positions occupied by these various lines :—

(*a*) is the central dorsal line, which is very faint in the type,

(*cc*) the dorsal white lines,

(*dd*) the lateral white lines,

(*bb*) the spaces between the central and side dorsal lines,

(*ee*) that portion of the sides of the larva lying between the dorsal white lines *cc* and the lateral lines *dd*,

(*fg*) the junction line between the adjacent segments A and B.

5. The central line (*a*), instead of being pale grey or smoky coloured, as it usually is in the type, is often orange or flesh-coloured, the spaces (*bb*) being still well marked and as dark in colour as the upper part of the sides (*ee*). In other specimens this flesh-coloured line is seen to get gradually wider, until, finally, in some larvæ it will be seen to occupy the whole of the space covered by the central line (*a*) and the adjoining spaces (*bb*), the flesh or orange colour then extending over the middle of the dorsal surface as far as the white lines (*cc*) on either side.

6. The spaces (*bb*) may be as dark as the upper part of the sides (*ee*), or they may be considerably paler, and their colour spreads, transversely, along the junction line (*fg*), between two adjacent segments, thus more or less interrupting the lines (*a*) and (*c*). When the orange line extends over (*a*) and (*bb*) the central portion (*a*) is sometimes lighter than the remainder of this space.

7. All the colours become pale shortly before pupation, and it is often difficult to determine how far the normal colouring has been modified by this approaching change.

8. I have by no means indicated all the variations of colour which may occur, but the above appear to be the most important, and I wish to emphasize the fact that there appears to be a complete series of intermediate forms, uniting the dark larva, in which the central dorsal line is scarcely, if at all, distinguishable and not orange coloured, with the larva in which the orange or flesh-coloured line occupies the whole of the dorsal surface between the dorsal white line *cc*.

9. The larva is shy and seldom exposes its whole body to view voluntarily. It constructs for itself, among the leaves on which it feeds, a shelter in which it lies during the day and in the neighbourhood of which it feeds at night. Consequently it is somewhat difficult to measure it, for if measured when at rest, crouching in its shelter, the measurements are too small, while it moves so quickly if disturbed that it is difficult to measure it when extended to its true length. Several measurements of the mature larva made by me showed its average length to be 1·26 inches and its mid-diameter 0·22 inches. The larva tapers to both ends.

10. *Eggs*—Are striate, yellowish or greenish in colour, oblong with long diameter 0·05 inch; are somewhat transparent, and the black head of the young larva can be distinctly seen inside the egg shortly before hatching. After hatching the empty egg shells are colourless. They are laid singly, usually on the back of the young leaves and generally in an angle between two veins, or where the lateral veins join the mid-rib. The youngest leaves are usually selected for egg-laying, so that the young larvæ may have plenty of soft leaf tissue near at hand when they emerge from the eggs.

11. The above description has been given in considerable detail, especially for the moth and larva, chiefly for two reasons, which are:—

(1) The imago is very variable, and in several cases the colouring and markings resemble those of *Hyblæa constellata.* The latter has recently been reported as attacking teak trees in Burma in company with *Hyblæa puera.* It is therefore possible that these insects may be confused, and in recording observations with the object of completing their life-histories, it is most important to make sure of the identification in each case. It should be remembered that *Hyblæa constellata* is separated from *Hyblæa puera* by two principal characters, which appear to be constant and are as follows:—

(*a*) *H. constellata* has the outer margin of the forewing excised below the apex and excurved at the centre, whereas in *H. puera* the margin is evenly curved and not excised.

(*b*) *In H. constellata,* in the anal angle, on the under side of the hind wing, there is a single black spot, whereas in *H. puera* there are two such spots.

(2) Mr. Stebbing has recently separated a variety of *H. puera,* which he has provisionally named *H. nigra,* the principal character relied on to distinguish the variety being the dark colour of the dorsal surface of the larva and the absence of any flesh-coloured dorsal line. I have shown, in the larval description given above, that there exists a complete series of intermediate forms, uniting the dark-coloured larva, which has no flesh-coloured dorsal stripe, with the larva in which this stripe covers the whole of the dorsal surface between the dorsal white lines. With such a variable insect I cannot but think it will ultimately prove impossible to regard *H. nigra* as a distinct or well-marked variety, and that therefore it is inadvisable to attempt to classify it separately, at all events in the present state of our knowledge.

LIFE-HISTORY.

12. *Food plant of larva.*—Hampson gives *Bignoniaceæ* as the food plant. During the rains of 1901 in Jubbulpore the insect was not very numerous, and although I searched carefully and repeatedly, I could only find the larvæ on *Millingtonia hortensis,* with the exception of two isolated individuals seen on teak on August 15th. I made several attempts to make larvæ

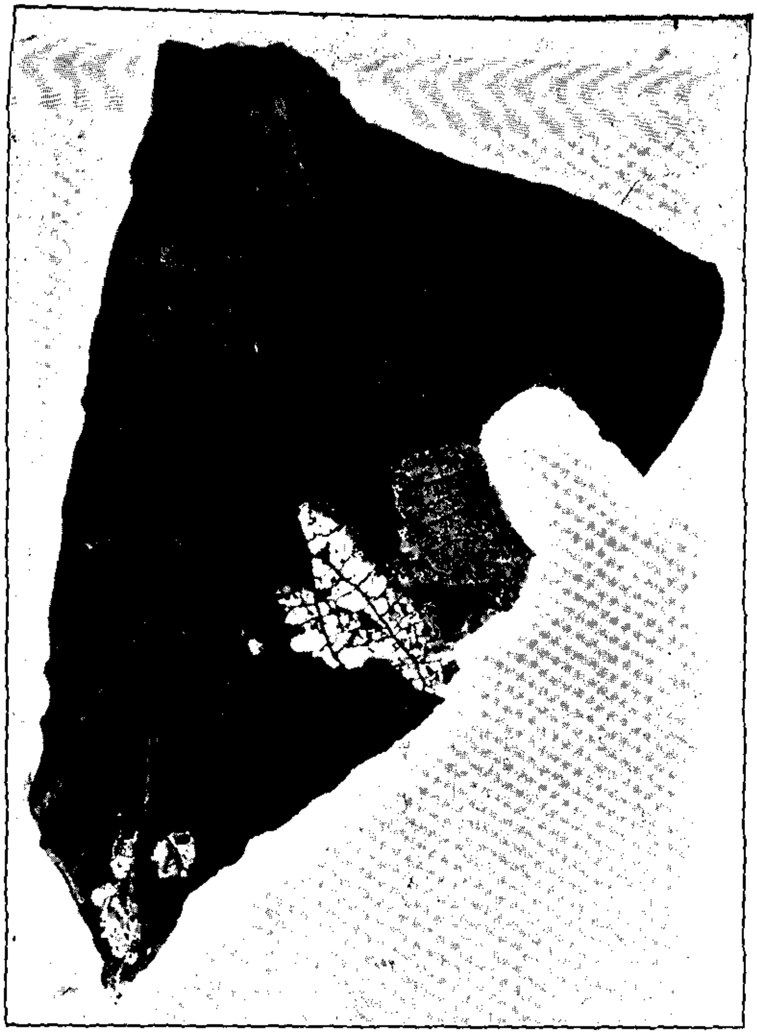


FIG. I.
LARVAL SHELTER CONSTRUCTED ON A TEAK LEAF by
Hyblœa Puera.

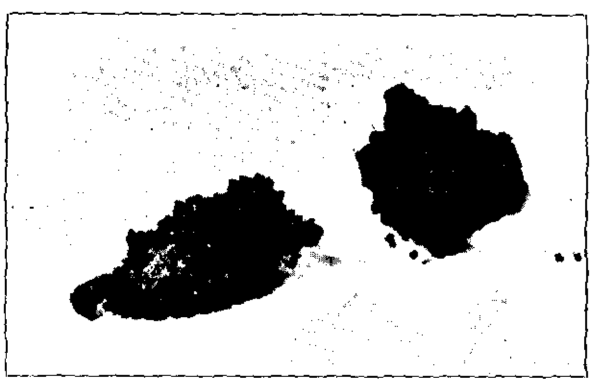


Fig. III.
PUPAL CHAMBERS CONSTRUCTED IN THE GROUND by
Hyblœa Puera.

bred on *Millingtonia* leaves eat teak leaves, but was not successful. If able to escape, the larvæ at once left the teak leaves to search for other food; if unable to escape and kept from other food, they died, or in some cases, if nearly mature, pupated. Very little, if any, of the teak leaves, however, was eaten in any case. Only one larva was induced to eat an appreciable amount, which I obtained from the leaves of a *Millingtonia* tree on 19th September and which lived on a teak leaf for 11 days, dying on September 30th after a change of skin. This larva constructed a shelter by cutting and turning over a flap on the edge of the leaf, which, together with the portion of leaf eaten by the larva close to the shelter, is shown in Fig. I. When fed on *Millingtonia* leaves I found that several larvæ attained their full development and pupated in 10 days, whereas this larva, fed on teak, although more than 11 days old, was then scarcely half-grown, and the photograph shows that it had only just acquired the power of biting through the fine veins of the leaf. In this case it was clear that the larvæ preferred the leaves of *Millingtonia hortensis* to those of teak, and it is probable that other plants belonging to the Order *Bignoniaceæ* are preferred to teak when they are available. It is also obvious that, in this case, the larvæ did not readily adapt themselves to the teak diet, and that many perished through their inability to do so. It therefore appears that the development of the larvæ can be considerably checked by destroying the supply of their favourite food, and this also indicates the enormous numbers in which the larvæ must exist in years when they are able to completely defoliate trees so dissimilar as teak and *Albizzia lebbek*, which happened in Jubbulpore in July 1900, as noted on p. 427 of the *Forester* for August 1901.

HABITS OF THE LARVÆ.

13. The larvæ, when disturbed, let themselves down by threads from the tree on which they are feeding, sometimes directly to the ground and sometimes remaining suspended for some time in the air, after which they pull themselves back again on to the leaves above. The larvæ acquire this power of letting themselves down by threads almost immediately after leaving the egg.

14. When irritated, the larva emits a dark green fluid, which it ejects from its mouth to a considerable distance.

15. As has been noticed above, the larva is shy and seldom exposes its whole body to view, always constructing hiding places for itself on the leaves on which it feeds. On leaving the egg the larva at first feeds on the soft tissue of the young leaves, but it soon is able to bite through the smaller veins, and it then cuts a small flap out of the edge of the leaf, which it pulls over and fastens to the upper leaf surface, thus forming a small shelter, inside which it lies, under the folded or curled leaf edge. As the larva grows the shelter is made larger to accommodate it. In the case of *Millingtonia hortensis* a single leaflet soon becomes too small to hold the larva, and several leaflets are then fastened

together to form the shelter. Fig. II, *a* and *b*, shows the front and back view respectively of the shelter of a large larva made on a piece of a *Millingtonia* leaf. I have unfortunately obtained no good example of the shelter made by a mature larva on a teak leaf, but I believe they are almost always constructed by rolling over a portion of the leaf edge.

16. The larva eventually destroys the whole of the green tissue of the leaf attacked, leaving only the main ribs with small portions of uneaten green tissue adhering to them here and there.

17. The larva does most of its feeding at night, but even when feeding, it usually keeps part of its body inside the shelter, into which it hastily retreats on being alarmed.

18. It is perhaps as well to draw attention here to the fact that *Pyrausta machœralis*, which is so often found attacking teak in company with *Hyblœa puera*, has been called the "Teak-leaf roller." This would appear to be a misnomer, and is due, I believe, to a confusion of *Pyrausta* with *Hyblœa*. The larvæ of *Pyrausta* when feeding on teak leaves do not, as a rule, roll up the edge of the leaves, but lie on the surface of the leaf, below a light weft of silk threads, whereas this rolling of the leaf-edge is very characteristic of the *Hyblœa* larva when feeding. Again, the larva of *Pyrausta* usually takes advantage of the most convenient cavity or depression available within which to pupate. In the case of damaged, dead and withered leaves the naturally curled up edge forms such a cavity, but here the rolling is not caused by the insect. When the larva pupates on green leaves, where naturally curled-in edges are rare, pupation in the rolled up edge is quite the exception, the larva usually taking up its position in a depression along the midrib, or lateral vein, and there forms its cocoon, drawing the sides of the leaf loosely together over it with a silky web, the cocoon being made to fit the cavity. The *Hyblœa* larva, on the other hand, when it pupates, as it sometimes does, on the leaves on which it has been feeding, constructs the pupal chamber in exactly the same way as its larval shelter on the same kind of leaf, all openings of course being closed. On teak leaves therefore pupation would take place in the rolled up end or edge of the leaf. Further, it appears probable that when larvæ of both *Pyrausta* and *Hyblœa* are feeding on the same trees, as is often the case with teak, the larvæ of *Pyrausta* will often utilize, as convenient places for pupation, the larval shelters made by the *Hyblœa* larvæ and vacated by them. Anyone casually observing the larvæ or pupæ of *Pyrausta* in these shelters, under the curled up leaf edge, would be apt to conclude that the rolling was done entirely by *Pyrausta*, whereas in reality the *Hyblœa* larva is responsible for it.

19. Seeing that this leaf rolling appears to be the exception and not the rule in the case of *Pyrausta*, I consider the term "leaf-roller" to be a misnomer, which is apt to give an incorrect impression of the habits of the larva.

Fig. 11*a*.
Front View of large Larval shelter made on a Leaf of *Millingtonia hortensis* by *Hyblæa Puera*.

Fig. 11*b*.
Back View of large Larval shelter made on a Leaf of *Millingtonia hortensis* by *Hyblæa Puera*.

20. Mr. Cubitt, in an interesting case of defoliation of teak by *Hyblœa puera*, recorded on p. 422 of the *Forester* for August 1901, Vol. XXVII, notes that only the tallest trees were attacked. This appears to be unusual, for on trees exposed to light on all sides, and which are consequently branched close to the ground, I have found that the larvæ do not by any means spare the lower branches, and that, if anything, the lower branches suffered most severely in the cases noticed by me. This, after all, was only natural, for the moths emerged from the pupal chambers, situated as a rule low down near the ground, and finding suitable young leaves for egg laying on the lower branches of the trees near them, laid their eggs there without troubling to fly to the highest twigs. As has been already noticed, however, the moth prefers to lay its eggs on the *youngest* leaves, and in the high teak forest seen by Mr. Cubitt the largest supply of soft young leaves would have been on the upper branches of the tallest teak trees, which alone were probably exposed freely to light on all sides, and the majority of the eggs would consequently have been laid on them.

MODE OF PUPATION.

21. Pupation may take place—

(*a*) In the leaves of the tree on which the larva is feeding.

(*b*) In the leaves of shrubs or herbs growing beneath the trees attacked by the larva.

(*c*) In dead leaves lying on the ground.

(*d*) In the soil.

As a rule the larvæ, when mature, quit the leaves on which they have been feeding and pupate in the leaves of the undergrowth below, or, in the absence of suitable undergrowth, in the dead leaves lying on the ground, and in the soil. At the same time pupæ are occasionally found in dead leaves lying on the ground beneath a thick undergrowth of shrubs, although the number of such pupæ is usually small compared with the number of pupæ lying among the green leaves of these shrubs themselves growing beneath the attacked trees.

22. The larvæ not rarely pupate on the leaves on which they have been feeding, even though there may be undergrowth below the trees and dead leaves on the ground beneath. In this case, if feeding at some height above the ground, they usually leave the higher branches and pupate on the leaves of the lower branches. Occasionally, however, the larva remains in its shelter near which it has been feeding, and pupates there.

23. From experiments made by me it appears that, when the leaves on which the larva feeds are close to the ground, there being no undergrowth, an unusually large proportion of larvæ pupate on the leaves of the attacked plants, and this is still more marked when there are no dead leaves on the ground below. This accounts for the interesting case recorded by Mr. L. S. Osmaston on p. 516 of the *Forester* for 1900, Vol. XXVI, in which the larvæ, which had been attacking young teak transplants in a

nursery, pupated in large numbers in the rolled up ends or edges of the teak leaves. Mr. Osmaston kindly informed me that the young transplants attacked were only 6 inches high, that there was no undergrowth of herbs, teak being thickly planted over a clean prepared bed, and that there were no dead leaves on the ground.

24. Pupation may thus take place in several situations, and the pupal chamber constructed by the larva exhibits great variety in shape and mode of construction. In dead leaves, depressions and hollows, caused by the drying of the leaves, usually exist, which, with a little manipulation on the part of the larva, form suitable pupal chambers. Green leaves on the contrary usually possess few, if any, of such convenient hollows. Again, green leaves have to be treated differently according to their texture; coriaceous leaves cannot be folded so easily as soft, flexible leaves and so on.

25. When pupation takes place on the leaves, the pupal chamber is usually constructed in one of the following ways:—

(a) The tip of the leaf is pulled down and the leaf folded transversely to its length, the cocoon being made inside the fold.

(b) A flap is cut out of the edge of the leaf and folded or rolled over.

(c) The leaf is rolled up longitudinally, the cocoon being placed inside the roll. With a large leaf only a portion of the margin may be thus rolled; with a smaller leaf the whole of one-half may be rolled in, or finally the whole leaf may be rolled inwards from each side towards the midrib.

To make the chamber quite secure the hollow end of the roll is sometimes closed by having the surface of another leaf fastened tightly over it.

(d) The surfaces of two leaves which overlap one another are joined together, pupation taking place between them.

(e) Several small leaves are tightly bound together in a variety of ways, the cocoon being made inside them.

26. It has been noticed above that when pupation takes place on the leaves of the species attacked by the larva, the pupal chamber is constructed similarly to the larval shelters, *all* openings of course being closed in the case of the pupal chamber.

27. When pupation takes place in the soil, the pupal chamber is formed of silk and bits of earth bound together. Fig. III shows two such chambers.

TIME REQUIRED FOR A COMPLETE GENERATION.

28. The average period required for a complete generation of the insect, as noted in the case of the generations bred by me at Jubbulpore, from August to December 1901, was as follows:—

	Days.
From pairing of moths to emergence of larvæ from the eggs laid by the moths	7
Larval stage	13
Pupal do.	9
Total ..	29

The average time for a generation is therefore practically one month.

It must be understood that the period here given refers to cases in which the larvæ were fed on the leaves of *Millingtonia hortensis*, and it is possible that the larvæ require a longer period for development when fed on teak leaves.

29. The eggs usually hatch in three to four days.

30. In the few cases for which I was able to obtain accurate dates, the moths lived from 7 to 9 days. Egg-laying continues for a period of several days, the first larvæ of each generation appearing some time before the later larvæ of the same brood. The generations thus overlap, and all stages of the insect may be found at one and the same time. As a rule, this overlapping is not so marked as in the case of *Pyrausta machœralis*, probably owing to the fact that the latter is usually far more numerous than this species.

Number of generations in the year.

31. In 1901, in Jubbulpore, one generation of the insect succeeded another without intermission from August to December, four generations being passed through in this period, and there was probably at least one generation before this in July.

The most severe attack by this insect as yet seen by me occurred in Jubbulpore in July 1900.

32. In the Central Provinces the larva, I believe, usually appears first in June-July, and leaves the trees towards the end of November.

Hibernation.

33. Hibernation appears to commence towards the end of November, but unfortunately I was unable to fix the date accurately, or to discover where and in what stage the insect hibernates. It is probable that it hibernates in the soil in the larval stage, but this requires confirmation.

Relations to the Forest.

34. It has been shown above that the natural food plant of the larva does not appear to be teak, plants belonging to the order *Bignoniaceæ* being preferred; also that the larvæ find some difficulty in adapting themselves to a teak-leaf diet, and that the larval development, at all events at first, if not later, is slower on teak leaves than, for example, on the leaves of *Millingtonia hortensis*. Generally speaking, then, mixed forests containing a large proportion of plants belonging to *Bignoniaceæ* would be more favourable to the development of the insect than pure teak forests would be, and, in the former, a certain number of the larvæ would be kept alive on the food which suits them best, in years which are unfavourable to the development of the insect on a large scale.

35. Of course in years when the insect is present in large numbers and the favourite larval food runs short in consequence, teak, in common with several other species, is attacked, and once

the insect gets established in a pure teak forest, the number of teak which suffer will of course be far greater than would be the case in a mixed forest.

36. It is interesting to note that in the case recorded by Mr. Osmaston referred to above, the nursery was a new one, the teak plants being the first ever raised there, and there were no teak trees within several miles. In this case it is probable that the larvæ had been living in the neighbourhood on the leaves of other species, and the supply of these running short had driven the insect to attack the teak.

ENEMIES.

37. The larva is a voracious feeder, but fortunately for the forest it has many and powerful enemies. It is very liable to a fungoid disease. The larva is usually attacked, but I have also found pupæ killed by it. The diseased larvæ and pupæ become discoloured, wet and flabby, and are filled with a yellowish brown liquid.

38. The larvæ are very susceptible to injury just before moulting, or pupating, and great care must be taken not to handle them then.

39. The larvæ and pupæ, the latter especially, are greedily eaten by birds, which pull open the larval shelters and pupal chambers to gain their contents. In Jubbulpore, in 1901, crows were particularly destructive.

40. Spiders occasionally eat the larvæ.

PROTECTION AND REMEDIES.

41. The following suggestions are made, of course, on the understanding that the circumstances of each particular case will determine to what extent other considerations, such as the necessity of curtailing expenditure or sylvicultural requirements, will allow of the adoption of any of the proposed measures.

(a) All trees and plants which are valueless from a forest point of view, and the leaves of which are a favourite larval food, should be cut out and destroyed as far as possible.

(b) Enemies, and particularly birds, must be protected.

(c) Undergrowth below the trees attacked should be cleared, if this can be done without damaging the forest, and dead leaves allowed to accumulate on the ground. A large number of larvæ would then pupate in the dead leaves and in the soil, and if pigs are allowed in the forest during the larval attacks, they would destroy a considerable proportion of the larvæ and pupæ.

(d) Nurseries should be kept clear of all weeds and dead leaves from April to December. The majority of the larvæ will then pupate on the plants, and both larvæ and pupæ can be then easily collected by hand.

The Training of Indian Forest Officers.

BY W. R. FISHER, B.A.

COLONEL PEARSON'S services to the Indian Forest Department in India and at Nancy are so great, that I am loath to differ in any way from the opinions he has expressed in the October number of the *Indian Forester*. There are, however, two points in which I consider his proposals unsound, and these are, as to the use of athletics for Forest students, and the selection of Edinburgh as the future training place for Indian Forest students.

The arguments which Colonel Pearson urges against training candidates for the Imperial staff of the Forest Service at Dehra Dun are conclusive. The excellent Forest School at Dehra Dun is already too small for the training of the Provincial staff of the Indian State forests as well as of the forest staff required by Native States. Three-quarters of the work there is done in the forest, and it is impossible to conduct this work satisfactorily with a large number of forest students, while the forests of Northern India differ materially from the tropical forests of Southern India. A second school, therefore, on the same lines as that of Dehra Dun, is required for the Forest staff of Madras, Bombay, Coorg, Mysore and other Native States of Southern India, to say nothing of Burma, for which an elementary forest school has already been established.

A reversion to the former Continental training of our Forest students is inexpedient for the reasons given by Colonel Pearson, and also because a much wider view of forestry is taken in the course introduced by Dr. Schlich into Cooper's Hill than in any other European forest school. French and German forest schools deal chiefly with the system of forestry practised by the State to which they are attached, and Continental forest students, therefore, do not gain a sufficiently broad view of forestry for Indian work. It is essential that our Indian Forest students should be taught forestry in Britain, by experienced Indian Forest Officers.

In case, therefore, the splendid foundation of Cooper's Hill should be abolished, Indian Forest students should, as Colonel Pearson suggests, be attached to a British University for a two years' course, followed by practical training on the Continent for one year.

Colonel Pearson, however, suggests Edinburgh University, preferring it to Oxford or Cambridge on the ground that 'many English University students waste their time at athletics, whilst the Edinburgh students are hardworking and conscientious workers.' It is well known that many students come to Edinburgh as mere boys and complete their course there at the ages of 19 or 20, when men usually come into residence at Cambridge and Oxford, and which is the age of our Indian Forest candidates. Many of the best Scotch students, also, after taking a Scotch University degree, come to Oxford or Cambridge to continue their studies

and such students would not be too old to compete with others in the Entrance examination for the Indian Forest Service, as some of them have already done.

As regards devotion to athletics, I had the privilege of of studying at Cambridge, St. Andrews, and Edinburgh, and found that athletics are as keenly followed in the northern as in the southern Universities. I took an active part in athletics at all three Universities and did not find my work suffer from so doing. Boating and football do not take up much time, and are forms of exercise admirable for young men, who sometimes employ their spare time in less profitable pursuits. Experience at Cooper's Hill has shown that many of the best of our men have been good athletes as well as high up in the Class Lists.

Colonel Pearson has often conducted the candidates for the Indian Forest Service in the stiff twenty-five miles walk, which, up to this year, has been an essential part of their qualifying examination. This walk has now apparently been discontinued by the India Office, though, largely owing to the consequent disqualification of feeble persons, it has afforded a physically fine body of men to the Indian Forest Department. I am sure that no one recognizes more fully than Colonel Pearson that *mens sana in corpore sano* is a necessity for Indian Forest Officers, and this can be secured only by persistence in active physical exercise. If, moreover, our men are trained at Cambridge, it will appear further on that many afternoons usually would be necessarily occupied by field-work, as is at present the case at Cooper's Hill.

Apart from the question of age—and it is highly inexpedient that our students should go to India till they have become mature men—the chief reasons in favour of Cambridge are as follows:—

There is an admirable agricultural class at Cambridge, the syllabus for which I will proceed to give.

There are in the neighbourhood of Cambridge well-managed and extensive woodlands such as are non-existent near Edinburgh.

The list of lectures issued by the Board of Agricultural Studies at Cambridge comprises agriculture, chemistry, botany, geology, agricultural chemistry, engineering, mechanics and heat, fungoid diseases of plants, economic entomology, book-keeping, mensuration and surveying. Were a Professor of Forestry appointed—which would be at once done, if the India Office were to transfer the Forest students to Cambridge from Cooper's Hill,—forestry would take the place of agriculture in this class for Forest students, all the necessary instruction in auxiliary subjects being already available. The presence of Dr. Ward ensures that the botanical instruction is suitable for Forest students and of the highest class.

As the lectures are all given in the forenoon, several afternoons a week are available for practical instruction in forestry and surveying, and for botanical and geological excursions.

The woodlands belonging to the Duke of Bedford are extensive, and are managed under a working-plan prepared some years ago by Dr. Schlich; through the kindness of the Duke they would be available for field-work in forestry. They consist of oak, beech and other hard-woods, also of pine-woods and other conifers and are only one hour's distance from Cambridge by rail.

Although the University of Oxford has not at present an agricultural class, they would certainly establish one were the India Office inclined to send Forest students there. Oxford is also better situated than Edinburgh as regards woodlands, and close to Oxford are the extensive beechwoods of the Chiltern Hills, while the Forest of Dean and High Meadow Woods, for which the late Mr. H. C. Hill made a working-plan in 1897, are easily accessible from Oxford by train.

Notes on Sandal.

1.—Root Parasitism.

In 1896 I made a note to the effect that I did not believe in the root parasitism of sandal. After a series of observations on the point, the only thing that I could discover were some small white tuber-like growths attached to the rootlets of small seedlings. The observations of Messrs. McCarthy and Barber were more carefully made and have given rise to further investigation. In the September number of the *Indian Forester* there is an excellent article by Mr. M. Rama Rao on the subject. He has pointed out that root parasitism is the rule in the Salem district. The same is the case in North Coimbatore, if one can judge from a series of observations made at Hassanur. This locality is specially suited to such observation, being rich in sandal. The trees are, on the whole, particularly healthy and give a large percentage of scented wood of excellent quality.

The first plant put under observation was a healthy 4-year old plant growing in a dense thicket. It was carefully dug out and the attached mud washed away. No signs of attachment were found, except some minute tubers similar to those noticed in 1896. The whole root system was extracted from the dense mass of surrounding roots. Root fibres and root hairs were found in considerable numbers, and there is no doubt that the plant was living quite independently and had no inclination to attach itself to any of the surrounding roots. This, however, was not the case with subsequent observations.

Starting with small seedlings of a year old, distinct attachments by means of the small white tuber-like growths were found in every case. Seedlings up to six years old were examined and the haustoria became more and more marked, being larger in size and of a reddish-brown colour similar to the root. In one case no less than eight attachments were found, besides previous attachments, not so much in the form of scars as of haustoria themselves

attached to the host, but detached from the sandal plant. Several instances were also found of haustoria, still attached to the sandal plant, which had evidently finished their work. In most of these cases the principal roots, to which the haustoria were attached, belonged to *Premna tomentosa*.

Finally, a considerable-sized tree, between 10 and 15 years old, was examined in the same manner, the root being extracted with much difficulty.

In this tree the attachments were very numerous, but the most striking were three distinct large haustoria about the size of a four-anna piece. The host in this case was *Zizyphus xylopyra*. Other roots attacked were *Premna tomentosa* and a species of *Grewia*. My observations, that the root hairs and fibres decreased proportionately with the attachment, were similar to those of Mr. Rama Rao. Especially in the large tree, though the root system was well developed, much of it was, so to speak, ineffective, and I have little doubt that the nourishment was taken up chiefly through the haustoria.

2.—CONGENERS.

A list of congeners is given by Mr. Rama Rao in the article referred to above. It might be very considerably added to as far as this district is concerned. In fact there is hardly a tree growing between 2,000 and 4,000 feet altitude with which I have not seen it associated. *Vitex alata* and *pubescens* are common in sandal areas, whilst two species of *Carissa* and *Zizyphus anoplia* are specially noticeable as forming the scrub in which it is most generally found. I should certainly put asterisks against *Terminalia chebula*, *Premna tomentosa*, *Zizyphus xylopyra*, and *Acacia sundra*. On the other hand I should not include *Litsœa zeylanica* or *Albizzia amara* in the list of congeners, though it is found with the latter at low elevations.

3.—GIRTH CLASSES AND WEIGHT OF SCENTED WOOD.

Some useful figures on this point have now been collected, and a few may be given for comparison with other districts.

(1) *Mavihalla Coupe. Altitude about* 4,000 *feet.*

Very few trees under 12″ girth gave any scented wood. In the few cases where scented wood was found, the average weight was only 183 tolas*

Girth class.	Number of trees.	Average weight of scented wood (including root). M. T.
12″—15″	19	0·322
16″—18″	38	0·488
19″—21″	33	0·780
22″—24″	18	1·640
25″—30″	17	2·599
31″—36″	46	5·270
Above 36″	21	8.037

* *Note*.—1 maund = 1,000 tolas = 25 lbs.

(2) *Kotadai Coupe. Altitude about* 4,000 *feet.*

Girth class.	Number of trees.	Average weight of scented wood (including trees without scented wood). M. T.
Under 12″	25	0·068
12″—15″	25	0·371
16″—18″	25	0·680
19″—21″	25	1·488
22″—24″	25	2·774
25″—30″	25	4·118
31″—36″	25	7·180
Above 36″	25	11·852

(3) *Talakarai Coupe. Altitude about* 3,000 *feet.*

Girth class.	Number of trees.	Average weight of scented wood (including root). M. T.
6″—9″	165	0·200
10″—12″	283	0·340
13″—15″	357	0·600
16″—18″	293	0·880
19″—21″	163	1·333
22″—24″	76	1·693
25″—30″	83	2·500
31″—36″	20	4·700
Above 36″	5	5·000

(4) *Karlia Coupe. Altitude about* 2,300 *feet.*

Girth class.	Number of trees.	Average weight of scented wood (including root). M. T.
6″—9″	39	0·385
10″—12″	180	0·463
13″—15″	304	0·787
16″—18″	141	1·049
19″—21″	63	1·613
22″—24″	56	2·016
25″—30″	26	1·579
31″—36″	14	4·658
Above 36″	..	*Nil.*

(5) *Kodampalli Coupe. Altitude about* 2,300 *feet.*

Girth class.	Number of trees.	Average weight of scented wood (including root). M. T.
9″—12″	19	0·560
13″—15″	26	0·800
16″—18″	23	1·560
19″—21″	24	1·600
22″—24″	12	2·500
25″—30″	13	3·270
31″—36″	9	6·600
Above 36″	2	9·480

The Mavihalla and Kotadai coupes adjoin and are at the same elevation, yet the difference of outturn is very marked. The

Karlia and Kodampalli coupes are at the same elevation but on different plateaux, over 20 miles apart. The difference of outturn is most marked.

Speaking generally, scented wood appears to form more quickly at lower elevations, but to increase less as the girth of the tree becomes bigger. Trees of large size are far more numerous at the higher elevations, which seems to point to a more advanced age of maturity.

Kodampalli has a particularly good outturn, but other coupes in the same locality show that it is by no means exceptional. Figures of this sort may give rise to much conjecture, but in my opinion only prove the immense variation of sandal even when grown under similar conditions.

4.—THE VALUE OF SANDAL LAND.

I have never seen any attempt made to value sandal land. Such valuations are very difficult on account of the patchy nature of the growth. In spite of these difficulties a few observations on the head may not be out of place.

In this district there are not a few acres which contain at least 200 visible sandal trees to the acre. I have recently seen many such on the Talamalai plateau, and will therefore apply the figures taken from the Kodampalli coupe on that plateau. Supposing that, in the next 40 years, we worked out these trees at the same size as we did those in 1899-00, we should get results very similar to the coupe actually worked in that year, *viz.*, 188 trees yielding 332 maunds of scented wood. The yield per acre per annum would be 8¼ maunds, valued at not less than Rs.40 net. This I admit is exceptional, but I am of opinion that, under careful treatment, we should be able to work up to this in most localities.

The value of more extensive areas may, however, be proved in a totally different way. The coupes of sandal include both reserved and unreserved land. The latter include not only wastes but also lands under cultivation from which trees are purchased by Government. Enumerations of immature trees have been made for the whole coupe area. Under these circumstances it is clear that a valuation made for the whole coupe is considerably less than it would be if only the actual sandal land were included. The area of Kotadai coupe is 960 acres. Assuming that in the next 40 years the immature trees will be worked out at the same size as those worked in 1902-03, a net revenue per acre per annum of over Rs. 21 is obtained. If the cultivated area were excluded, there is little doubt that the result would be doubled. This area is particularly rich in sandal and may be taken as sandal at its best. I will now consider it at its worst. The Karlia coupe (northern portion) was worked in 1896-97. Between 1893 and 1895 very extensive thefts took place, and in 1895-96 the southern portion was worked over, only the stumps from the illicit fellings being removed. The coupe contains 5,040 acres, of which not less than two-thirds are cultivated land containing no sandal. To

be on the safe side I have taken only half as unproductive. This area was again worked in 1903 and 1,714 trees produced 1,420 maunds of scented wood. The net revenue per acre per annum, even under these very unfavourable conditions, works out to Rs. 1-12-0, which is equal to twice the assessment levied on cultivated lands in the neighbourhood. A natural inference to draw from these figures is that the land on these hills is far more valuable for growing sandal than any other crop, and fortunately this has, to a certain extent, been recognised by Government and still more so by the local revenue officers.

For some years past the various Collectors of the district have steadily opposed the gradual removal of all tree growth from these lands, and of late years a Collector has made some very advanced proposals for protecting this growth. It only remains to be seen if Government will accept these proposals, which I have little doubt they will do if the facts are clearly put before them. An accurate survey of the hills has recently been carried out, and with proper maps the preparation of such estimates will be facilitated.

5.—DISEASES.

'Spike' has recently found its way into the district. The localities attacked show that it has not been introduced by contagion from Mysore. Other trees, congeners of sandal, seem to be similarly attacked. From the locality in which it has been found I judge that it may not be impossible to trace the origin of the disease to fire. I hope to deal with this after more prolonged observation.

24th October 1903. P. M. LUSHINGTON.

Notes on the Forest Nursery and Plantations in the Panch Mahals.

YOUR issue for November contains a note on forest nursery and plantations which would have been all the more interesting had Mr. Pearson extended it a little and told us something more about the plantations themselves. He states that some foresters have condemned such works while others believe that good results can be attained at a reasonable cost.

I have just spent some five and-a-half years in the Godavari district of the Madras Presidency—a district with a great variety of forest, from high, which will produce very large timber, to mangrove forest. The district contains about one thousand square miles of reserved forest and eight ranges.

Three of these ranges, bordering on the Central Provinces, contain a valuable species peculiar to itself. Thus in one the prevailing species was *Xylia dolabriformis*, in another teak and in the third *Hardwickia binata*. The rainfall in this tract varied from about 45 inches in the Hardwickia range to about 70 in the Xylia range, the teak range being the central one and the Xylia the easternmost. Prior to reservation the whole of the forests in these three ranges had been subject to shifting cultivation, in addition to which the configuration of the country with the aid of the Godavari and Saben rivers gave every facility for the exploitation and transport of timber, which was rafted to a great central market lower down the river. Immense trees can be found here and there left uncut by the shifting cultivator, surrounded by smaller poles. Now in spite of all the bad treatment that this teak in the central range has received in the past, it persists in coming up, and has fought hard against being exterminated. It produces a harder wood than the Burma and West Coast teak and takes a beautiful polish so as to be scarcely recognisable as teak, and every stick of it could be sold to-morrow, so great is the demand. As the work of settlement in the district was completed it was possible to

pay attention to working-plans, but a thousand square miles is a large area, and even after five and-a-half years I had to leave the district without ever having seen one reserved forest at all, and another only in the far distance. In this teak range the Survey of India party had just started work, so that detailed maps would not be ready for some time. A preliminary plan was therefore necessary. As it was obvious that the policy for the forest was improvement of the stock of teak, the main provision of the plan was for a series of experiments to ascertain how this increase in the stock of teak could be best brought about. It was estimated that twenty-five thousand acres might be dealt with in time out of the seventy-five thousand acres of reserved forest in the range. Here the necessity of a forest bureau is surely very obvious. Here is a range easily exploited, with a large market, which supplies other districts besides this one, all of which have direct water communication with it as well as with a seaport, and in which teak struggles to grow and only requires protection. At present, after years of bad treatment, there is little teak over five feet girth, but we do not know to how large a size it will grow in this locality, and there is an insatiable demand for all sizes. In this Presidency one sees less of men of one's own department than of any other. One may occasionally see men of adjoining districts on social occasions at "weeks," but there are no professional foregatherings, so each man has, in a question like this one of improvement of teak, to work it out for himself. It was thought that in time the taungya system might be introduced, but the subject was considered too important to leave the experiment to others, *i.e.* cultivators, until the best method had been found out. The teak occurs in patches, so one such patch of twenty-five acres was taken in hand. All the crooked teak were cut over for coppice and the good ones as well as the good ebony poles were left. The good saleable poles of other species were cut for coppice and sold and the balance cut and burned. Pits a yard apart and one foot square and deep were dug and the earth put back before seeds were sown. As the seeds from the local species were not considered good, a ton of seeds was obtained from the Coimbatore district, S. I. This was found to be far more than was needed, as four seeds were put in each square after being soaked for forty-eight hours. There has been a good monsoon, and when I left the district 12 per cent. of the seeds had come up and more were apparently coming. Now this is only an experiment and may be all wrong, and if so it might have been worked differently had there been a bureau to refer to as to how to act in such a locality. These seedlings will have no shade, but if seeds are sown with cereals the resulting seedlings would have none either. It remains to be seen if a reasonable percentage of the seedlings will survive, in order to prove whether the experiment is a success or not. It must, however, be remembered that each seedling established should in time be a seedbearer, for much of the present teak is

only of coppice origin. If this method does not prove a success, then it must be seen how much shade is required and so on, or whether *it is not better to have nurseries and plant direct in* preference to sowing. On this point it would have been interesting to hear how Mr. Pearson's seedlings have done when planted out. Of this I am, however, sure, that a method of either sowing or planting can be found that will prove of great advantage to immense areas of forest, which contain such a great proportion of undesirable species and where little is being done at present to increase the stock of saleable species. It is a pity that there is not a central bureau to refer to, as it would save a lot of time in local experiments. In this instance the sale proceeds of the poles sold well covered all the cost of the experiments. It would be interesting to hear of other experiments to improve the stock of the superior species over considerable areas. It might be mentioned that there is good general reproduction in these forests except for teak, as the good seedbearers were mostly felled, it reproduces well in coppice and by shoot.

H. F. A. WOOD,
District Forest Officer, Kurnool District.

The Assam Forest Report, 1901-02.

In the *Indian Forester* for the current month, when reviewing the Assam Forest Report for 1901-02, you have assumed that at the time of the preparation of the Dambu working-plan fifteen years ago, no attention was paid to the question of the extraction of produce from the forest. As I was largely responsible for the preparation of the plan in question, I write to say that your assumption is incorrect. A cart-road was being made to the forest while the data for the plan were being collected, and this road was, if I recollect rightly, actually in use for the transport of scantlings before the plan was published. All the Forest Officers concerned, from the Inspector-General downwards, believed that this road would prove to be suitable and sufficient for the purpose it was intended to fulfil, that is to enable timber to be transported from the forest to the plains. The omission, therefore, to which you refer, did not exist. Even had your supposition been correct, your homily on so elementary a professional principle as that involved would, I think, have been unnecessary. Now-a-days the orders regarding the preparation of working-plans are far too precise for the question of the extraction of produce to be lost sight of.

Your sneer at the scarcity of labour being said to have delayed the preparation of the new Goalpara working-plan could hardly have been made were you acquainted with the prevailing local conditions.

This is a point on which Forest Officers now serving in Assam can enlighten you, if they think fit, better than I can, who have not seen the province since 1891.

CAMP CHAMBA, C. P. FISHER,
11*th November* 1903. *Deputy Conservator of Forests.*

Prizes at the Imperial Forest School.

IT will doubtless interest many of our readers to know that the students at the Imperial Forest School are not asked to work hard through the two years' course without being offered some reward and being shown some honour at the end of their labours. We append below a list of the prizes which will be offered at the end of next March. We feel sure that while the Service as a whole is deeply indebted to the Honourable Member for the kindly thought which has led to its offer, there will be keen competition amongst the students for the prize so graciously offered by the Hon'ble Sir Denzil Ibbetson, K.C.S I., since to win it will mean to have earned distinction indeed.

The prizes to be offered at the end of March next will be as follows, provided the Board of Control considers they have been earned.

(i). *The Member's Prize.*—Offered by Sir Denzil Ibbetson, K.C.S.I., the Hon'ble Member for the Revenue and Agricultural Department of the Government of India.

The prize will be awarded by the Director and the School Staff to that one of the outgoing students who is, in their opinion, likely to make the best Forest Officer. All qualifications will be taken into account, whether intellectual, professional, moral, or physical. The prize, of the value of Rs. 75, will be given in the form of books, instruments, or other useful articles, to be selected by the winner subject to the approval of the Director.

(ii.) *A Prize for the best Senior Upper Class student.*—That is, for the student in the Senior Upper Class who has during the whole course received the greatest number of marks, all subjects together.

(iii). *A Prize for the best Senior Lower Class student.*—That is, for the student in the Senior Lower Class who has during the whole course received the greatest number of marks, all subjects together.

(iv). *A Prize for Forestry.*—This will be a prize for that student of the Senior Upper Class who has obtained most marks in Forestry.

(v). *The William Prothero Thomas Prize for Practical Forestry.*—This prize will be given to that student of either the Upper or Lower Senior Class who, in the opinion of the School Staff, has shown the best practical knowledge of Forestry. It will be in the form of a book or books.

(vi). *The Botany Prize.*—For the student of the Senior Upper Class who obtains most marks in this subject.

(vii). *The Forest Engineering Prize.*—For the student of the Senior Upper Class who obtains the largest number of marks in this subject.

(viii). *The Campbell Walker Prize.*—For the Madras student of the Senior Upper Class who has obtained most marks in Forestry during his school course.

(ix). *The Inspector-General of Forests' Prize.*--For the best athlete in the School. This will be annual and will be adjudged by the School Staff to the best all-round man.

A Morning after Goral

The sun has not yet shot up over the neighbouring peaks as we breast the steep winding path leading to the crest of the mountain we are bound for. It is a fresh beautiful morning in early June, and at the elevation we are at—between 7,000 and 8,000 feet—crisply cold. The keen morning air and the stiff climb send the blood coursing merrily through the veins, and one feels in tune with the glorious scene around one. Are we not many, many

miles distant from the scorching plains, right up amongst the most glorious scenery the world contains, in the mightiest of mountains, the Himalayas. Is not one blessed with a sound wind and good lungs and head and is not one full of hope that the crest of yonder ridge will disclose the whereabouts of a beast as yet unmet and unshot—an animal whose level plain is the rockiest and most precipitous of precipices. Does not a feeling of contempt pass through one as one remembers the Home sportsman. He who with time and money both at his disposal, year after year is content to shoot tame deer and barn door pheasants and call it sport, whereas a little energy would enable him to obtain the sport of kings. But he would have to work for it! Wind and limb, head, hand and eye must be good for mountain shooting, as often a false step or slip means a drop into eternity over some terrific precipice. This does not, however, come within the contemplated bill of fare of our home sportsman.

As we toil up the slope a rush in the bushes to our right brings the rifle to the ready, but almost before one has had time to try and peer through the growth, a couple of short sharp barks proclaim the animal a barking deer, alarmed at such an early visit from the two-legged biped. Will the barks have raised the hill-side one wonders! Luckily they are not repeated. Further up two monal pheasants get up, offering a lovely shot, and fly off with their queer piercing whistle. A sudden halt of the shikari and I hurry up, only to find another barking deer, this time down the khud. Not much time would he have allowed for a shot had it been wished for, for with a whisk of his white tail he is off at breakneck speed. Up, up we climb, and at last reach the crest; every open patch of grass and rocky precipitous slope is searched, but in vain. Either the barking deer have roused them or our eyes are not sharp enough, for no horn of goral appears. After further fruitless search we turn into a small path and drop down the hill on to a small contour path someway below. Just before reaching the crest something had bolted down through the jungle in this direction without our having caught sight of it. After winding along the rocky cut for a mile, suddenly the shikari drops like a stone and I promptly follow suit. 'To the left of the big pine in front,' he whispers, and I crawl into his place. For some time nothing can be made out at all; then a minute greyish blotch, taking a sort of goat-like shape, defines itself to our earnest gaze, and one or two other dots I take to be companions. I worm along a few yards further and then sit up. From here I must fire for I can get no closer. Had I been above I should have tried, but being on the same level it was too risky, as the animals were on the *qui vive*. Resting my rifle on my knees I take a full sight for my estimate of 150 yards and fire. The goral gives a great bound in the air with arched back and appears to then spring straight over the khud. Its companions disappear like phantoms. Hit, I was sure, and in my excitement I bark my shins and nearly

come a cropper in trying to get hurriedly over breakneck ground. A very short examination shows blood. At first a little and then in patches, and I no longer doubt that I have shot my first goral.

Step by step we track it up, and as is usual with these animals, it very soon takes us to a place where the hillside is virtually a

precipice. Slowly and carefully I follow my nimble-footed companions. I vaguely wonder how many generations it has taken to give them their easy gait and swinging stride over the rocky khud side and how many would be required to give the average Englishman even a fraction of their agility. I plod along, sticking to my rifle and thanking the good star which induced me to put on a stout pair of football boots, which answer here even better than nails. At last we come to sheer slippery rock, and this tries my powers to the utmost. However good one's head, one can't walk on shiny rock at an angle of 60°. I get over encouraged by frantic pantomime from my orderly, who appears on the high road to lunacy and to losing me my goral. In a woful plight I reach the other side, blowing and shaking, for the last 100 yards or so have been real hard work. After a little time I make out a slowly moving grey speck (the hind leg is broken at the hip, so I am told), and steadying myself as much as I can, I fire. The beast stops dead for an instant, I thought preparatory to falling, and then with incredible swiftness bounds off on three legs over some terrific country, rounds a point and is out of sight. I mutter something not complimentary to myself, but am not particularly downhearted—though I really believe that shot to have been a miss—as I feel certain of getting my beast. How little I knew the goral! But the khud had now to be negotiated. The hill from a point some 1,000 feet above us dropped down at a sharp angle, but was more or less clothed with trees—deodar, spruce and silver fir. This growth, however, stopped just above us, and the khud inclined strongly into a practically sheer rocky precipice, with just a ledge here and there to get along by. Luckily there were tufts of grass in niches which proved a great help. This lasted to the corner round which the goral had bolted. My companions proposed that they should go straight and that I should climb up to the forest and then come along in that, but I was far too keen to go this round and said I would follow them. All went well except on one or two occasions when I spread-eagled myself (how one gets into these weird positions I don't know—a kind of tying oneself up into knots!) and had to be hauled out. Twice the men overran the blood in their eagerness and had to try back. At last we got round the corner, and the trail took us up to the tree growth, then round another corner, where a tree had fallen across the ledge we were on. Here we lost the blood and had to spend some time hunting for it. I had my rifle in the hollow of my arm when a rush in the deodar growth above, a dull grey blotch for an instant, and the goral was off down the khud back on its old tracks again. He passed close to the orderly, who saw the hanging leg and a large blotch of blood on the quarter. He yelled aloud in his excitement and has not been allowed out shooting with me since. Back again we went, and I made for a big craggy rock sticking out on a spur and hanging sheer over a precipice from which I thought I might be able to spot the beast. All below

me was, however, quiet and tenantless, the precipitous rocky slope lying bathed in a brilliant sunlight, and as it was warming up by now I had little hope of finding the goral in the open unless he fell. After searching every spot I was able to I returned to where I thought the men would be and found them right enough, squatting!! Oh! how the native loves to sit! To my excited questions they replied that there was no blood in the direction he had gone and so it was useless to look for him. I could not make it out at first, but I soon saw that the blood having ceased to flow, the patch on the flank would soon dry in the sun and there would be no further stains left. I now began to realize what goral shooting in this kind of country means. A wounded beast invariably makes for the worst possible country, and the chance of finding him here is very small. I made the man hunt about for another hour and then had to give it up. It was very annoying, and I could not help thinking of the sufferings of the poor brute, which would never live after the large amount of blood he had lost, we having seen the grass in places quite sodden with it. It was a hot tramp back on what I believe was meant to be a path, but it was entirely overgrown when it did not consist of naked rock. And yet it was enjoyable. The country and the glorious mountains all bathed in a flood of sunlight were magnificent, and one felt that the crowded city and civilization were far—very far from us that morning. The mountain air was beautifully fresh and the birds trilled and carolled sweetly around us, and oft and anon from some woody glen far below us the sweet notes of the cuckoo would vibrate tremulously on the air. Men were sent out to search the foot of the precipice, but without result, and a heavy storm coming on washed out all the blood stains. So ended my first experience of goral shooting, and the loss of a good head was due to over-confidence, want of knowledge of the elementary principles of the sport, and last but not least, bad shooting. But the broad road of failure will often show the bye-path to success, and this I found later on to be the truth in my case.

THE VAGRANT.

The British Association at Southport.

COMMERCIAL ASPECT OF AUSTRALIAN FORESTRY.

BEFORE the members of the British Association at Southport on Wednesday, Mr. E. T. Scammell, F.R.G.S., formerly commercial representative for the West Australian Government, delivered an interesting address upon "The Forest Resources of Australia available for British Commerce." Mr. Scammell said:

One of the most important duties requiring the early attention of the Federal Government of Australia is that of dealing with the forest resources of the Commonwealth. At present the forest laws and regulations in force, according to the opinion of the Victorian Royal Commission on Forestry, 1901, are 'weak, unsystematic and inefficient.' This has been acknowledged at different times by the various Governments of the Australian States, and desultory efforts to introduce some scheme of State regulation have been made, but no scientific and comprehensive plan on the lines laid down by France, Germany or British India has, apparently, been seriously considered, or, at any rate, attempted. Referring to the need of forest conservation and management in Greater Britain, Professor Schlich says: 'Surely the time has come, or, rather, it came some time ago, for a more vigorous forest policy on sensible lines throughout the Empire Let us strive to introduce systematic forest management, more particularly into Canada and Australasia.' The question is no doubt beset by great difficulties, but where there is a will there is also a way. Above all, let the self-governing colonies consider the magnificent example which has been set them by India, where the preservation of the State forests has now been put on a safe basis, for the everlasting benefit of the people of the country and the Indian exchequer. Humboldt says that 'men in all climates'—by the indiscriminate felling of trees—'prepare at once two calamities for future generations—a want of wood and a scarcity of water.' In order to avoid these calamities, which will as surely fall upon the New World as the old, unless prevented by wise and timely action, it is incumbent upon British Colonial Governments to give the question of forest control and development their most careful and enlightened consideration.

I am glad to know that the labours of the Victorian Commission have resulted in a strong recommendation being made to the effect that the action of the Government of India should be followed by the Legislatures of Australia. It is satisfactory also to note that the Western Australian Government have lately appointed a commission for the purpose of obtaining information and of recommending measures for dealing with the forests of that State, while New South Wales and Queensland are considering proposals having similar objects in view. The way, therefore, is being prepared for concerted action on the part of the Federal Government by co-ordinating, as far as may be possible, the efforts that are being made by the various States of the Commonwealth, and by advising the adoption of measures which, while applicable to the separate States, shall be suitable to the country at large.

The Forest Areas of Australia.

The magnitude and importance of the interests involved may be judged by the fact that the forest areas of Australia comprise 107,037,000 acres of marketable timber, or nearly half the areas of the forest lands of Europe, excluding Russia. Of this area

Queensland possesses 40 million acres, New South Wales 20 million, Victoria 12 million, South Australia 4 million, Western Australia 20 million, and Tasmania 11 million acres. To this should be added a considerable area in Queensland (over 100 million acres) and in Western Australia (over 70 million acres) covered with inferior timber, which has a local value for building and for general purposes.

Many, if not most, of the important forests of Australia are fairly accessible from the sea, as the best grown and most valuable timbers are mainly coastal. This especially applies to the belts of jarrah and karri in Western Australia, which occupy clearly-marked and distinct areas on the hill ranges of the south-west, which skirt the coast for some hundreds of miles; and also to Tasmania, whose forests of blue gum and stringy bark grow down to the shores of that forest-clad island. In Victoria the southern forests, which correspond very largely to those of Tasmania, are not far from the sea, while in the northern part of the State, where the timber is akin to that of New South Wales and Queensland, considerable areas border on the River Murray. The subalpine regions of Victoria, however, where some of the finest timber of that State is found, are at present practically inaccessible. In New South Wales and Queensland a number of the largest and most valuable belts of forest land lie between the dividing range and the sea; but in both these States there are large areas too far from the coast to render them serviceable as immediate sources of supply.

THE COMMERCIAL TIMBERS OF AUSTRALIA.

The timbers of the Commonwealth are of many varieties and some of them of high commercial value. The chief of these, as shown in the great work of the late Professor Baron von Mueller, are the eucalypts, which are indigenous to Australia, and are found in all parts of the country. Of the valuable timber alone there are over 150 species. Besides the eucalypts, there are many kinds of casuarinas (the Australian oak), some conifers (the Moreton Bay pine), the cypress pine, the brown pine or colonial deal, and others, many acacias (the Australian wattle), banksias, and numerous other varieties.

At present, however, the range of Australian woods available for British commerce is limited. Western Australia and Tasmania are the only States that have seriously dealt with the question of exporting timber, or of using the forest resources as a valuable commercial asset. New South Wales is beginning to enter the field, and Queensland should be able to utilise her timbers for the supply of outside markets. But before these States can hope to compete with Western Australia or Tasmania, or in any way to command the attention of timber users in this country, they must issue, under authority, a definite and reliable statement of the timbers available for export. General statements on the

subject—of which the Government books are full—are of no practical use, nor are the tests, proving the strength and general value of the timbers, such as those issued by the Queensland and New South Wales Governments, unless accompanied by reliable data as to the timber actually available. For example, two of the most useful eucalypts of Australia—ironbark and tallow wood—to which special attention has recently been called by the New South Wales Government, are said to be so restricted as to render an export trade of any magnitude impossible. There are, however, other varieties of timber in New South Wales and Queensland, of which there should be an ample supply. In the case of Victoria and South Australia, notwithstanding the proposed efforts to conserve and increase the forest resources of these States, there is little probability of any export trade in timber being possible for many years to come. Our attention, therefore, for the purpose of this paper, must be confined, practically, to Western Australia and Tasmania.

Western Australia.

The leading timbers of this State are the well-known jarrah (Eucalyptus Marginata) and karri (Eucalyptus diversicolor), which occupy a computed area of 8,000,000 and 1,200,000 acres respectively in the south-western district. The average size of matured jarrah trees is from 90 to 120 feet in height, and from 3 to 5 feet in diameter. The stems are straight and clean, and rise 50 to 60 feet without a branch. Karri is a still finer tree, its height averaging 200ft., diameter 4 to 6 feet, and its stem rises branchless from 120 to 150 feet. The colour of the matured woods is red, and it is difficult, even for experts, to tell from the material itself the difference between them. The usual test is by burning, when jarrah is found to leave (ordinarily) a black clinker and karri a white ash. Both timbers are largely used for harbours and dock purposes, railway sleepers, and wagons, and street paving. For structural works karri is preferred, as it possesses greater lateral strength than jarrah. But for general uses jarrah is (locally) in much greater demand, and is esteemed the better wood. These timbers, when sound, possess, in common with some other Australian woods, great immunity from the attacks of marine and land insects, and are comparatively non-inflammable. The former characteristic renders them suitable for sea work of every kind and for use in damp ground, while the latter renders them useful as a fire-resisting material, on account of which, I understand, an order has recently been placed for karri sleepers for the Baker Street to Waterloo tube railway by the Underground Electric Railways Company of London, Ltd. The durability of karri and jarrah is universally recognised. Samples of timber which had been in use for piers and railways and for underground work for many years (such as those shown at recent exhibitions in Paris, Glasgow and London) prove that they

compare favourably with the best hardwoods of the world. The usefulness of these woods for street paving in this country is also well known.

Of the other timbers of this State available for export Tuart (Eucalyptus gomphocephala) occupies the first place. This timber, in strength and toughness, is one of the best, if not the best, of all Australian woods. But the limited area it occupies renders a large export trade in it impracticable. Red gum (Eucalyptus calophylla) is a strong and useful wood, and has a very wide range. It requires, however, to be carefully selected, as it is often marred by numerous veins. These, however, exude a gum which possesses important medicinal properties, and is used locally for tanning. The term "red gum" is common to many Australian eucalypts, particularly to the Eucalyptus rostrata of Victoria and the Eucalyptus resinifera of New South Wales. Wandoo (Eucalyptus redunca) is a wood that needs to be better known. It covers a considerable area, and it is computed that there are from 6 to 7 million loads of marketable timber available for use or export. It is well suited for railway and wheelwright work. York gum (Eucalyptus loxophleba), another widely-distributed timber, is a strong, tough wood, suited for general purposes. The same also may be said of the yate gum (Eucalyptus cornuta) and other eucalypts of this nature, of which this State and Australia generally possess a great variety. The Acacia saligna (a species of wattle) supplies a valuable tannic acid—mimosa tannin—of which the bark contains about 30 per cent. The well-known raspberry jam (Acacia Acuminata) is a beautiful wood, suitable for cabinet work. Another acacia, the badjong (Acacia microbotrya), is used for barrel staves and soft wood joinery. There are many other timbers in this State—casuarinas, banksias and conifers—suitable for building, furniture and fancy work, which are available for export.

Tasmania.

The most important and best known tree of the Tasmanian forests is the blue gum (Eucalyptus globulus). Its name is derived from the colour of the young growth. In size it compares with jarrah and karri. The colour of the matured wood is golden yellow to purplish brown or buff. It is in considerable demand for harbour works. Good piles, like those supplied for the national harbour works at Dover, can be obtained up to 100ft. in length, with only a moderate taper. It has been tried for street paving in London, though with only moderate success. If sound and well selected, blue gum is one of the most important and valuable trees of Australia, and, according to recent reports by the Government of Tasmania, is available in any quantities. On account of its rapid growth, and the pungent and odorous exhalations from its leaves, it has been widely planted in Southern Europe, particularly in malarial districts, with most beneficial results. In South Africa, India, and particularly in the Southern

and Western States of America, extensive plantations of blue gum have been made. In a report on "Eucalypts Cultivated in the United States," issued by the U.S. Department of Agriculture, 1902, this tree is described as the best all-round eucalypt. As an illustration of its use for harbour purposes, the report states that a contractor, who was constructing a pier at Oceanside (California), required a few piles of Oregon timber to complete his contract. As these were not, for the moment, to be had, he obtained from a neighbouring plantation some piles of blue gum. When it became necessary, some years later, to repair the pier these were found to be the only sound piles in the structure. 'The demand for these piles,' the report states, 'is now greater than the groves of eucalyptus can supply.'

Stringy bark (Eucalyptus obliqua) is a more widely distributed tree than blue gum. It attains an immense size. The timber varies considerably, according to the situation and soil in which it grows. It is used for similar purposes to blue gum, but it is more subject to gum veins, and has, therefore, to be carefully selected. It should be serviceable for street paving, but its tendency to warp and shrink renders careful seasoning and preparation necessary.

Among the other timbers of Tasmania which are available for export, blackwood (Acacia melonoxylon) and myrtle (Fagus cunninghamii) are the best known and most in demand. Blackwood is extensively used for furniture, panelling for railway carriages, wainscotting and interior fittings. It resembles cedar in appearance. Alcock & Son, of Melbourne, use it for billiard tables, and Collard & Collard, of London, for pianos. It has lately been supplied to the Admiralty for gun carriages, having passed the necessary test in the Government arsenals. Myrtle has been favourably reported upon by Messrs. Ransome, sawmill and mechanical engineers of Chelsea, for its strength and high finish. Fine examples of its use, with blackwood, for dados and wall linings may be seen in London.

In addition to these there are the Huon pine (Dracrydium franklinii), an exceedingly fine timber, light and strong, which should constitute a useful and valuable commercial asset for local and export purposes.

New South Wales and Queensland.

I do not propose to give any detailed description of the timbers of these States, since, as already indicated, sufficient particulars are not to hand to justify any confident expectations of a continuous supply for commercial purposes. The only timbers from New South Wales that are being exported to any extent are blackbutt (Eucalyptus pilularis), which is being used for sleepers and railway wagons, and tallow wood (Eucalyptus microcorys), which is being sent to South Africa for use as sleepers. Blackbutt is in colour a lightish yellow or brown. It grows to a height of from 50 to 150 feet, with a diameter of from 2 to 4 feet. Like other Australian

hardwoods, it is liable to warp, and requires careful seasoning. There is a difficulty at present in securing large sizes for exportation, for which there is an increasing demand. Tallow wood is of a clear yellow or light reddish colour when newly cut, but changes afterwards to a pale brown. Its average height is from 100 to 120 feet, and its diameter 6 to 8 feet. Its common name is due to the greasy nature of the wood. It is largely used in Sydney for street paving, and with blackbutt and box (Tristania conferta) is being tried for that purpose in Westminster.

CONCLUSION.

My object in bringing forward at these meetings a practical subject of this nature is to aid, as far as one is able, the efforts that are being put forth by scientific, as well as commercial, men to promote the interests of our Colonies, the development and progress of which cannot fail to be of deep concern to this Association. It will, I am sure, be readily granted that the more widely the products and the possibilities of these great Colonial possessions are known, the more clearly will the fact be accentuated that our interests, whether scientific, industrial or commercial, are one.

At the conclusion of the address, Mr. C. C. Lance, commercial representative of the New South Wales Government, remarked on the practical character of the paper, though, at the same time, he felt that Mr. Scammell had scarcely done justice to the woods of New South Wales, which were more varied than those of any other Australian colony. Considering the size of Australia, it was only natural that there would be a great diversity in the timber, and although, generally speaking, eucalyptus was the principal, that in itself varied a great deal. Jarrah and karri were the timbers that had been brought more prominently before the public notice, and to West Australia belonged the credit of having developed this industry. New South Wales was now coming forward, as was illustrated by the fact that contracts have been secured with the Cape railways for a large number of sleepers. With Mr. Scammell's remarks respecting the non-flammability of Australian woods he quite agreed, but was of opinion there had been some stupid naming. For instance, turpentine would suggest that the wood bearing that name was highly flammable, whereas just the opposite was the case. From a commercial point of view, there were too many different names for timbers which were so much alike. He agreed that the Government might do more by preparing statistics of the quantity of timber available, and would certainly represent this to them.

The Chairman (Mr. A. C. Seward, M.A., F.R.S., President of the Botany Section) said the members of the Association were always glad to hear something of the varied resources and nature of timbers. Sometimes botanists were apt to forget the importance of the wider prominence concerning forestry, and it was appropriate to have this matter brought before them. On behalf of the section,

he expressed their gratitude to Mr. Scammell for having introduced the subject.

Mr. Scammell illustrated his remarks by means of a series of limelight views, and subsequently invited the company to inspect an interesting collection of samples of Australian woods.

Home Timber in Wales.

The home timber trade in Wales at present is rather quiet; nevertheless, the tone is fairly well for the approaching winter. Naturally, at this time, merchants are desirous to clear the woods of all timber felled, if they have not already done so. It is not wise to leave logs lying about until the wet weather sets in, as in most cases our woods are awkwardly situated, and badly laid out, and the result is that if the logs are left until winter, unless we have hard weather, much more labour is required.

On the whole, we have had a very catching wet summer, and we have of late been in woods, soft and boggy, which it would not be wise to take teams into should the wet continue. Much of last spring's oak has been delivered; nevertheless, there is much still lying out for want of customers. And yet, comparatively speaking, there has not been so great a quantity felled as in many years past, when the supply has been scarcer. The demand has fallen off in many of the local districts, as was anticipated, but we believe it will prove differently during the coming winter.

Generally speaking, oak continues at much the same price. We have been over several lots of felled timber of late; some of them are fairly good, while others are altogether unsaleable at required prices.

Two lots we inspected would cost the manufacturer by the time they arrived into his yards about 1*s.* 10*d.* to 2*s.* per foot, and they were not of the first-class type, some of the logs being crooked and others rather small and rough.

There was a time in our own remembrance when crooked oak would fetch a top price for shipbuilding and repairing. We have seen ship repairers, when a vessel was bound to be at sea in a certain time, pay almost any price the merchants would ask, but such times are now numbered with the 'good old days.'

Some of our old wide-awake country timber dealers, when they have a crooked lot on hand, never fail to point these qualities out; but they are generally met with a shrewd shake of the head. Yet there are remote instances in which a call comes for a crook, when a good price is always demanded for goods which before could not be disposed of.

There are some lots, as we have previously mentioned, lying out now, and where merchants have signed contracts for the supply of oak scantling, it would be the better thing for them to secure them than to put it off until later, as there may be in a month or six weeks' time haste with many to purchase.

Speaking of elm, we hear of nothing very pressing. It is a timber which in South Wales is certainly becoming scarcer. We do not mean to say that all our elm is gone. Far from that; yet it is a very prominent fact in our observations that our groves and hedgerows of elms are farther apart and visibly becoming fewer. If Wales had to depend upon her own elm, two to four years would denude her.

Passing over during the last week or so several large estates in the neighbourhood of our consuming centres, we have come across many a stately elm, sycamore, beech, ash and birch of considerable commercial value and sylvan beauty, proving to us that much of the land producing nothing at present could and would produce hard-woods of the finest quality.

We were on a range of hills the other day—the highest peak being 2,903ft. above sea level—and we could not refrain from admiring the beautiful panorama which presented itself to our view. But, alas! the land, which at one time at this season of the year was covered with golden corn waving in the autumn sunshine, was reduced chiefly to grazing meadows, and appeared very bare and brown at that; and many a tract of land which was once covered with oaks and other hardwords had nothing but a rank growth of scrub and bush.

In making our ascent we made a few practical observations. At the base of this range of Welsh hills we found larch, fir and hardwoods growing luxuriantly, and larch continued up their sides. The last tree we passed was a birch in a very stunted state. Gorse, fern, lichen and grass grow a long way up their slopes, and even to the top of some. Now, the tree lover and scientific arboriculturist will tell you that where these grow there are trees which will grow also, so there, in our endeavours and labours to prompt the reafforestation, we take courage, and will yet hope that the day is not far distant when these denuded tracts and those treeless hills and slopes may be clothed with young trees which will in due time add to the beauty of our landscape and also a revenue to our beloved little Wales.

It is a pity now to see so many tracts of land in Wales that would yield timber crops, but which are now lying in a barren state—in the grasp of despairing solemnity.

We find that many of the hills of Wales are composed of limestone conglomerates and sandstone. There is a kind of stone found in some of them of a bluey-red, or red tinged with blue colour. Evidently a sandstone, but of a harder nature than the ordinary red sandstone. These stones or rocks are good bottoms for tree planting, and, furthermore, even on some of our mountain sides, there are rich soils to be found in fairly large tracts which afford splendid sites for many of the pine families.

When will the Government take this matter up and once again reclothe timber-growing districts? Scientists tell us that our vast Welsh coal-fields are the product of submerged forests,

and from personal observations we do not altogether disagree with the theory; and if such be the case, what forests it must have taken to have formed our coal deposits! And if we have to thank the forest for the coal mine, we contend that it is a burning shame to neglect forestry to the awful extent as is done in Wales to-day.

In reference to her present-day woodlands, let us cite one instance. Not long ago we were allotting several coppice woods and plantations for sale in the heart of Wales. These particular woods were planted, and some naturally formed in good soil and on splendid sites; but they had been neglected. The undergrowth was rank and thick, excluding light and air from the young, and choking many of them. Nevertheless, even under these conditions we found hundreds of vigorous, healthy young ash and oak—some young saplings to a height of 30ft., and even 40ft. Now, what would these young trees have made under proper treatment? The cry is, Where shall we get ash and oak from? Our answer is, There is plenty of room in Wales to grow them. Why, along the side of our brooks and little rivers, in deep ravines, the ash delights to grow, and will grow, too. But our land wants nature to plant, to rear, and to produce. Nature did so in ages gone by, when our British forefathers roamed the forests as savages. But these natural forests are gone and gone for ever in Wales. Therefore, human skill and cash must assist her in these days, not merely by planting but by bringing our woods and forests under scientific and experienced management

We may say here that we cannot in any way recommend mixed planting—pine, larch and hardwoods. The more we see of it the more the failure presents itself to us. A plantation of larch, oak, ash and alder came under our inspection only a week ago. It would be helpful, perhaps, just to note how we found it. The larch was cancerous and stunted in the majority, and covered with the insect pest—quite a failure. The oak, ash and alder we found, in most cases, in a healthy condition. And our recommendation was to fell all the larch and thin the oak and ash out. This plantation was planted on a marly loam on red sandstone on a steep declivity, with a north-east aspect, and a brook of fresh water at the bottom.

The prices of timber in Wales at the present time are:—

	Per ft.
Elm, delivered into yards	1/4 to 1/6
Ash " " "	1/6 " 2/6
Poplar, especially the variety of *Populas Nigra* ..	1/3 " 1/5
Beech hard to dispose of	— —
Sycamore, very little offered	1/6 " 2
Larch, for boat, boards, etc.	1/2 " 1/4

Mining timber 12/ to 14/ per ton, delivered at collieries.

Larch holds the premier position in the market and consequently always commands the highest price.

Planting Rubber with Tea in Ceylon.

THESE pages have recorded from time to time the progress in the planting of rubber in connection with coffee in Ceylon and the Straits Settlements, or the replacing of coffee with rubber, on account of the declining profits of coffee culture, and the feeling of the planters that it is better not to have 'all of one's eggs in one basket.' Of late a similar attitude in regard to rubber has been shown by the tea planters, whose interests in these colonies are even more important than the coffee interest. At the fifteenth annual meeting (June 15) of the Ceylon Association in London--maintained for the promotion of the sale of the Ceylon product--the tea situation in that colony was reviewed at length by Mr. H. K. Rutherford, who has sent us a copy of his remarks. In spite of the energetic efforts made to promote the sale of Ceylon tea [$273,234·86 was spent for this purpose in America alone in 1902 by the Ceylon planters] the lower price at which Chinese tea can be bought gives the latter an advantage, even in British markets, without regard to any question of quality. The production of Ceylon tea has increased rapidly, while the prices obtained have declined, and the prospect for extending the consumption does not now seem bright. After referring to these points, Mr. Rutherford said:

While I am on the subject of supply and demand, I would like to bring to your notice another factor, a factor which I do not think has been taken into account, but which I believe will be a most important factor in the near future in the Ceylon tea enterprise. As you are aware, during the last three years the tea proprietors of the low country have been certainly making no profit, if they have not been working at a loss. On that account, as you will remember in the days of coffee, when they turned their attention to cinchona, they are now turning their attention to planting these tea estates with rubber. I was astonished to find it stated in the administration report of the Kegalla district that no less than 4,000 acres of rubber had been interplanted among the tea in that district. That is only one district, and if we consider what is being done in other districts, I would not like to say how much rubber has been planted, but I would not be at all astonished to learn that from 10,000 to 15,000 acres of low country estates have been interplanted with rubber. In the Kelani valley, Kalutara, and minor low country districts there are 60,000 acres of tea, planted in land all more or less suitable for the cultivation of Pará rubber and producing 25,000,000 pounds of [black] tea. It becomes a question that is worthy of consideration as to what is going to happen, for if we take also into consideration the possibility of green tea being a permanent production, even if it does not increase beyond the 12,000,000 pounds now produced, we are face to face with the fact that if this rubber succeeds better than tea, the whole of that 25,000,000 pounds may in time vanish altogether from the black tea output.

Mr. Rutherford was elected president of the Ceylon Association for the ensuing year. He is also a director in The Ceylon Tea Plantations Co., Limited, one of the largest planting enterprises in the colony. The extent of their operations is shown by the fact that they now have invested £248,460 [=$1,209,129·49] of capital, the amount having been increased several times since 1887, when the amount stood at £75,000. During sixteen years the net profits have aggregated £587,598 5s. 12d. [=$2,859,548·70], and after paying liberal dividends, and writing off for depreciation, a reserve fund of £100,000 has been accumulated. Part of this has been invested satisfactorily in planting cocoanuts, and now the planting of rubber has been introduced on the estates. These details, by the way, are derived from recent annual reports of the company. In addition, Mr. Rutherford writes to the Editor of *The India Rubber World:*

My company, The Ceylon Tea Plantations Co., Limited, have planted up about 2,000 acres of their low country tea estates with Pará rubber. The work was started in 1897 and completed this year. The rubbers are interplanted throughout the tea and thriving well—I am also interested personally in the cultivation of rubber in the Klang district [State of Selangor] of the Straits Settlements, and in that quarter of the world the product promises great things.

ALCOHOL FROM SAWDUST.—At the recent Congress of Applied Chemistry, held in Berlin, Simonson of Christiania described a method of utilising sawdust in the production of alcohol, which the *Country Brewers' Gazette* prints. About two tons of sawdust are boiled with sulphuric acid for three hours, the liquid matter being then extracted by pressure, neutralised, left to stand for 18 hours to cool and clarify, and then fermented for four or five days. The resulting alcohol is afterwards distilled and rectified; and making ample allowance for loss in the latter operation, the yield of spirit is said to be about 2½ quarts per cwt. of sawdust. Trials made with the method on a manufacturing scale are claimed to have demonstrated the possibility of working at a profit, and of opening up a new industry in timber-producing countries, where enormous quantities of sawdust are annually wasted.

NEW TOOL FOR TAPPING RUBBER TREES.—A device for grooving or tapping India-rubber trees is the subject of a United States patent [No. 730299] granted to Fayette S. Robinson, of Boston. It has been designed for use particularly on plantations of *Castilloa elastica*. Briefly described, the device comprises a tongs-like structure having jaws to embrace or partially embrace a tree, and an adjustably supported knife adapted to cut the groove in the tree. When the device is in position, the movement thereof up or down the tree, or around it, causes the knife to cut the proper channel in the bark. The construction of the tool permits

the jaws to widen as they are drawn downward, to allow for the *increasing diameter of the trunk. A vertical groove may be cut,* or a horizontal groove, or a spiral groove around the tree, as desired. While it is supposed that a single grooving knife will be used preferably, the plan of the invention permits additional knives to be inserted. The patent has been assigned to Ferdinand E. Borges, Secretary of the Consolidated Ubero Plantations Co. (Boston).

THE AMERICAN BUREAU OF FORESTRY IN THE PHILIPPINES.—We note that our American cousins have imported some of their characteristic dash and up-to-dated-ness into their newly acquired possession, and the forest department of the Island appears to have already commenced work on the best possible lines. The American Bureau of Forestry have inspected the forests and prescribed rough plans of working, under which a royalty is charged on all trees felled but that only trees which have previously been selected and marked by the department can be felled and logged by the lumbermen. The forests are thus preserved from that reckless and extravagant cutting which so often follows and accompanies the taking over and opening out of a country by a highly civilized Power. There can be little doubt of the value *of the American Bureau of Forestry. India still sits and waits* for hers!

COOPER'S HILL.—Our latest news on the subject of the prolongation of the life of Cooper's Hill is by no means reassuring. If public opinion on the subject in India was at all taken into account at home, we should have no fear for the old college. Headed by the leading journal, our Allahabad contemporary, the Indian papers are practically unanimous in their condemnation of the policy of closing an Institution which it is admitted on all sides has turned out a useful body of public servants, for the sake of putting money into the pockets of the few. Can the policy be said to make for the better working of the Departments concerned! *Salus populi suprema lex.*

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Reproduction of Teak in Bamboo Forests in Lower Burma.

By H. C. Walker, I.F.S.

As we are now extracting a large number of seed-bearing teak trees there must be a decrease of reproduction; and since it is desired not only to maintain but to increase the future outturn of teak, natural regeneration should be aided very considerably artificially.

The works carried out for this purpose are:—

(1) Taungya plantations.
(2) Wathon plantations.
(3) Improvement fellings.

The largest sums of money are spent on the first of these works. There are, however, several objections to be urged against taungya plantations.

Firstly, the growing stock has to be sacrificed. Secondly, it is generally thought that plantations, by offering a concentrated food supply, are responsible for the increase of *Hyblœa puera* and that they form, therefore, centres of contagion. Having full access to the light, a seedling in a plantation is able to offer great resistance to this pest, and a second crop of leaves is usually put out to replace the ones destroyed; but the pest is not confined to plantations, and it is possible that naturally-grown seedlings, being handicapped by their struggles for existence with other species, suffer very greatly.

These operations are very intense and involve considerable labour.

The following are the works usually carried out. Selection of a site, supervision while firing, counting numbers of seedlings, weedings twice in the 1st year, and once in the 2nd and 4th years, cleanings in the 6th, 8th and 10th years, thinnings every 10 years till maturity.

Owing to the labour involved the area is insignificant as compared with the area other than plantations in a division, but often exceeds in size that of a German division. The works are somewhat similar but are considerably more difficult, owing to the fact that the growth of weeds is very rapid, and particularly

owing to the fact that these plantations are very scattered and great loss of time is caused in travelling. It follows therefore that areas other than plantations are greatly neglected (as is proved by the figures in annual reports).

The method of taungya plantations is well suited for exotics or trees not naturally suited to the locality, but not, I think, for a tree like teak, which is capable, if grown under suitable conditions, of competing successfully with its numerous rivals. In a taungya plantation, however, we create artificially conditions unsuited to teak, as is proved by the fact that without weeding no seedlings survive.

Teak, however, is indigenous in Burma, and seedlings spring up naturally in great profusion, and without subsequent tending a large number reach maturity. It is clear therefore that by imitating nature reproduction can be increased at a small cost, and if so, it is opposed to sound economic principles to establish teak in such an elaborate and expensive manner as plantations.

The other two methods of reproduction are based on theories of natural regeneration. As far as I can gather there are three principal theories.

What I think may be called the official theory (although contradictory or illogical statements often occur in official documents) is that natural regeneration of teak corresponds with the flowering of bamboo.

This theory implies that teak cannot bear the shade of bamboos. In the case of Kyathaungwa jungle (*Bambusa polymorpha*) which only flowers once or twice a century, it must be assumed that natural regeneration of teak must be very dense, since the *annual* waste in the older age classes must be made good only after periods of 50 or 100 years. Similarly, regeneration of Kyathaung must be dense in order that it must re-establish itself in the same proportion as before. As soon as the cover of bamboo is removed, the year after flowering both seedlings of teak and bamboo must be supposed to spring up together, and it is therefore an essential feature of this theory that it must be assumed that the former is of faster growth than, and able to compete very successfully with the latter.

In Prome division, however, I had the opportunity of seeing several wathon plantations in areas where Myinwa, (*Dendrocalamus strictus* had flowered gregariously. In forming these plantations the operations were considerably more elaborate than was necessary if what I have stated must be assumed is correct.

I found however that the bamboo seedlings grew faster than, and killed out the teak, unless very heavy weedings were made, and I found that in the older plantations had almost entirely killed out the teak.

If my statements are correct (and they can easily be verified) this theory of teak regeneration is incorrect.

All the objections I have urged against taungya plantations apply equally to wathon plantations, and also, as the formation is made by departmental agency, the work is more expensive. As teak is associated with the gregariously flowering Kyathaung over large tracts of country, the correctness or otherwise of this theory is of great importance. The theory is easy of verification, as it is only necessary to ascertain that in Kyathaung areas no reproduction has taken place since 1850 (or whatever may be the exact date of the last general flowering) and if, as is maintained, teak is found in clearly defined age-stages, the information can be obtained of the exact dates when this bamboo flowered during the last 200-300 years by counting the annual rings on teak stumps.

Although wathon plantations are not classed as experiments, yet at the same time, data for a cut and dried scheme for establishing teak when the Kyathaung flowers do not appear to have been collected, and also although it is the intention of the Forest Department to spend numerous lakhs of rupees on these operations, the above mentioned theory has not been verified.

This does not seem to me to be in accordance with sound economic principles.

There is a variety of this theory that bamboos should be cut just before the seed ripens. To cut bamboos is, however, expensive, as the cutting of one clump of bamboo such as Kyathaung is a day's work for a cooly (*i.e.*, eight annas), and cannot be done on a large scale owing to the labour difficulty and the small size of the staff for supervision. There are other obvious objections to this theory.

The second theory, which is, however, not very popular, is that teak can stand a limited amount of shade and springs up under the bamboo, but owing to its sensitiveness to friction, is unable to pierce the canopy, and therefore remains stationary until the bamboo flowers and dies, and that when this occurs the advance growth of teak, having a considerable start, is able to keep above the bamboo seedlings. There are several obvious objections to this theory, and no methods are based on it.

The first theory is based on the idea that teak can stand no shade; the second that it can stand a little shade but no friction; there remains therefore the theory that teak can stand a limited amount of shade and friction. This latter theory is becoming more popular, and even in official writings it may be seen that some officers believe that improvement fellings in bamboo forests aid natural regeneration of teak.

I must own that my experience is very limited, but from what I have seen of the teak forests of Lower Burma, this latter theory seems to me to be most probably correct. My idea of the life-history of teak is somewhat as follows :—

That where there is no shade whatever a teak seedling is usually unable to compete with grasses and other vegetation

which benefit to a greater extent than teak from the light, as may be seen in any poongzoi. On the other hand, teak is somewhat of a light demander and cannot stand much shade, but that its maximum power of competing with its rivals is attained with a degree of light and shade between these two extremes; that the greatest amount of natural regeneration of teak is effected when bamboos have reached the permanent and stationary state of maturity, and not immediately after flowering or when they *have not completed their maximum height growth. That teak* seedlings spring up in places were the shade is less dense than usual, in gaps in the bamboo, etc. That as the most penetrable point of a bamboo canopy is where they bend over and form as it were a dome, and as also most light is let on to the ground immediately under this point, which is in most cases equidistant from the bases of the neighbouring clumps, this is the spot on which a teak seedling has the most chance of springing up and reaching maturity, but that it sometimes happens that a teak seedling grows *to one side of the most penetrable spot, in which case the leading* shoot is often suppressed or killed by friction; but that sometimes a side branch takes its place and pierces through the canopy, and that this occurrence causes a kink in the bole The main principles on which I think methods for aiding reproduction in this class of forest should be based are, that seed should be sown in every place where a seedling would have a chance of success, and secondly that the number of such places should be artificially increased.

These forests are, however, pretty well covered with vegetation, and supposing my ideas were correct, not many seeds per acre could be sown. In the first place there is only room for one seedling between each group of bamboos at a spot under the centre of each dome, but such spots are distant from each other about 9 yards, so that at the most only 60 seedlings could be planted or sown per acre.

In the majority of these spots, however, the shade would be too great, so that only some 5 to 10 spots could be usefully sown up per acre.

As regards increasing the number of these spots, vegetation may be divided into two classes, bamboos and tree growth. It is often held that when bamboos are cut more numerous shoots are sent out but of inferior height growth, with the consequence that the shade is increased. It is also held that bamboo cutters improve teak reproduction. These beliefs are contradictory. Bamboo cutters, however, never cut new shoots but only old ones and prefer the outer ones. A new shoot invariably goes straight up, and the culms which die are, I think, always those that bend over most, or, in other words, overhanging is a sign of old age. If this is the case I think it is possible that a few of the culms which overhang most might be cut away in order to lessen the shade without affecting the quantity or quality of the new shoots

in the same way that lopping an old branch has not the same effect as pruning a small branch.

A tall dense bamboo like Kyathaung takes up a great amount of space and naturally tends to cause timber trees to be far apart. It is, however, by no means a shade bearer, and a large tree by its shade tends to make the bamboo canopy more open. When, therefore, such a tree falls or is felled, a considerable amount of light is let on to the ground. It is after such an occurrence that, in my opinion, most teak is regenerated naturally, and by felling large inferior species of trees and sowing seed in the gaps thus formed, much good would, I think, be done.

It will be seen therefore that I am in favour of "improvement fellings combined with dibblings" on a large scale. This is by no means an original method of my own, as it was advocated in the early days when forestry was first taken up in Burma. It has, however, not yet been brought to a high pitch of perfection, and there is one strong objection to it, namely that many if not the majority of eminent foresters who have studied the matter carefully, hold theories entirely opposed to this method.

Trained officers have been studying these forests for nearly 50 years, and it may be thought that a great mass of information concerning the reproduction of teak had been collected and was at the disposal of any one who was desirous of obtaining it. I have not found this to be the case, but on the contrary have found that senior officers hold views on the subject which appear to me to be contradictory although dealing with fundamental points.

Although the trees in Europe have been for a long time under observation, one is greatly struck by the number of experiments which are constantly being carried out, but although the reverse is the case in Burma, very few experiments seem to have been carried out.

Problems of light and shade as they affect tree growth require carefully recorded observation. On a typical sample plot, by measuring and recording rate and manner of growth, it is possible to form a better estimate than by studying the growth of a tree in the forest in mass, as to remember the difference in growth of individual seedlings or trees is a great tax on the memory, and observations are rendered more difficult owing to constant transfers to localities where the conditions of the locality may differ.

If, therefore, our knowledge of the reproduction of teak is as limited as seems to me to be the case, the remedy would be, I think, to carry out systematic and recorded observations and experiments.

As I have been finding great difficulty in discovering what facts may be taken as established, I venture to hope that some officer of experience will oblige me by giving me some information on this subject.

"Spike" Disease among Sandal Trees.

BY M. RAMA RAO, MADRAS FOREST DEPARTMENT.

I HAVE read with considerable interest all the articles that have appeared in the *Indian Forester* on the above subject. I have also read Mr. Muttannah's notes, dated 26th March, 3rd and 16th May, 1903, his letter dated 12th May to Dr. Butler, and Dr. Butler's reply thereto, dated 3rd June 1903.

2. Although Mr. McCarthy was the first to bring to notice the existence of this disease, his memorandum on the subject has not appeared in the *Indian Forester*, and I have therefore missed a perusal of it.

3. The following are the salient features of the disease observed by the several writers on the subject. They are as follows:—

(1) The spike is found only in those sandal tracts of Coorg and the adjoining Mysore districts that have been invaded by lantana.

(2) It has not been observed outside the lantana region, nor even in the lantana covered tracts of the Hassan and Shimoga districts.

(3) The main symptoms of the disease are (*i*) *externally* "an increased vegetative activity and a failure to form flowers," (*ii*) *internally* "an excessive production of starch, together with certain structural alterations in the tissues."

(4) The disease may appear in all parts of a tree, or only in certain parts of it, even in a single branch, while the other parts of the tree may remain normal and healthy.

(5) It is communicable from tree to tree according to Mr. Barber and Dr. Butler, but whether it is contagious or infectious or both has not been definitely stated or affirmed by them.

(6) Microscopical examination of the affected trees, conducted by these two gentlemen, has not revealed the existence of any parasites or fungi sufficient to account for the disease.

(7) Dr. Butler suspects circulation of some poison in the sap as a probable cause of the disease, while Mr. Barber thinks that the origin of the disease is in some way connected with the death of the root-ends and sucking organs (haustoria) of the sandal.

(8) In the midst of spike-affected tracts, healthy trees are not uncommon, where sandal is associated with other species of plants with or without lantana.

(4) Mr. Muttannah thinks that the disease is neither contagious nor infectious, and that it may be due to (*a*) old age, (*b*) injury to roots by fires or hurt, (*c* suppression or strangulation by climbers, and (*d*) fungoid, parasitic or epiphytic growth. Since the investigations of Mr. Barber and Dr. Butler have proved the absence of cause (*d*), it may be eliminated. As regards the other three causes, I think they, too, do not account for the disease at all, for all of them do exist as they have existed for

long in the sandal tracts of the Salem district, where we do not come across spiked sandal trees at all.

5. I have been of late devoting attention to the study of the root-system of the sandal. The result of my study is in entire accord with the observations of Mr. Barber, in respect of the important part that its root parasitism plays in the economy and development of this tree. The sandal is admittedly a surface feeder, its tap-root rarely ever extending beyond a depth of 5 feet or its lateral roots beyond a few inches of the surface. This characteristic is probably the outcome of its roots attaching themselves to the roots of other plants. It is very sparing in producing root hairs and root fibres, as compared with other species, and this paucity of such root appendages, so essential and abundant in the case of non-parasitic plants for the absorption of nourishment directly from the soil, is probably also another resultant of its root-parasitic habit. My observations have led me to believe strongly that the sandal depends almost entirely on the roots of its neighbours for its nourishment. If, therefore, those neighbours are also surface-rooted like itself, any injury to their roots by drought, fires or other causes may retard or disable them from performing their functions properly, and this must tell seriously on the growth of their guest, the sandal. On the other hand, if the hosts are deep-rooted species, the sandal will continue to thrive, or at any rate to keep itself alive in spite of drought or other injurious causes, because its deep-rooted hosts are not so easily affected by such causes, and will therefore furnish the nourishment it requires.

6. Now, the lantana is a comparatively low shrub with a superficial root system. Its rapid and gregarious growth, forming an impenetrable thicket over extensive tracts, generally prevents other species growing under its cover except isolated plants which have outgrown it. Mr. Barber has found the sandal forming root connections with the lantana and drawing its nourishment therefrom. Owing to the absence of other species, as generally happens in the lantana-invaded tracts, the sandal has to depend solely on the latter, attacking its roots in such a way that they become, in course of time, vitiated or even exhausted. When this stage is reached, the root-ends and haustoria of sandal, by which it is connected with the roots of the lantana, die also, and the supply of nourishment, including water to the sandal, is cut off. But the process of assimilation by its leaves continues until the reserve materials in its crown are used up and exhausted. Owing to the deprivation of the necessary mineral ingredients and water, the starch formed by assimilation cannot become converted into growing materials in its tissues, and it, therefore, remains in the cells of the leaves, etc. in large quantities; hence the superabundance of starch, as is explained in para 23 of Mr. Barber's report. As observed in para 27 of the same report, when the root-ends of the sandal die, fresh adventitious roots are rarely ever formed

from the older parts of the root system. This I have observed in the roots of even healthy trees. The exhaustion and decay of the roots of the lantana and of the root-ends of the sandal are greatly accentuated by fires, which must affect the surface roots of both the species.

7. May not the foregoing remarks explain the real origin of the spike disease, or at any rate afford a right clue to the solution of the mystery.

8. It will doubtless be asked, as indeed I have already been asked by a friend, how this explanation will solve the problem of the existence of healthy sandal trees in the midst of spike-affected areas, and of the absence of spike disease in the lantana tracts of the Hassan and Shimoga districts. Not having seen these tracts myself, I cannot venture to give a direct answer to this question, but I shall put forward a suggestion, in the hope that it may induce those concerned to make a careful inspection of the localities and to verify the correctness or otherwise of the view that I have ventured to submit. The sandal sends out its roots far and wide, for they have been found at least a hundred feet from its base. Some of its congeners (hosts) also send their roots over long distances. Thus, for instance, I have seen a root of a young *Albizzia amara* extending to 50 ft. and covered with the unmistakable cushions formed by the sandal haustoria throughout its length; similarly, a small root of *Acacia cæsia* was covered with the cushions throughout its length of 22 feet. I could cite other instances, but these will suffice for the present purpose. At some distances from the healthy sandal trees in the tracts affected by the spike, there may be isolated trees and plants of other species with whose roots the roots of the healthy sandal may have formed root connection, but owing to the distant situation of such trees, this circumstance might escape an ordinary observer unacquainted with the root systems of these species. In such cases, the presence or absence of lantana does not affect the sandal, since the latter is independent of it, being furnished with its nourishment from the distant species. May not this be the case in respect of healthy sandal in the midst of affected tracts? If this surmise prove correct, then similar circumstances, perhaps on a larger scale, may explain the absence of spike disease in the lantana tracts of the Hassan and Shimoga districts. Besides, the sandal being a comparatively small-sized tree, the requirements of several trees in the matter of nourishment can easily be supplied by the roots of a single well grown host. I have myself seen at the Forest Office, Denkanicota, six sandal trees with girths varying from 25 to 18 inches, flourishing luxuriantly in the neighbourhood of only two *Inga dulcis* trees, both of which are about 2½ feet in girth at breast height.

9. Whether the above explanation sufficiently accounts for the existence of healthy trees in the midst of affected tracts is capable of easy verification by careful inspection of the localities

and by ascertaining whether there are any congeners of the sandal within easy reach of its roots, and if so, to what species of plant they belong, and whether their roots have been attacked by the sandal roots. I hope some Forest Officers in Mysore and Coorg, who have opportunities and facilities for investigating this subject, will furnish information on these points.

10. By way of testing the correctness or otherwise of this explanation, I think it will be interesting to plant quick-growing species, such as the *Inga dulcis*, *Albizzia lebbek*, *A odoratissima*, *Acacia cæsia*, in the midst of the lantana areas in which the sandal is still too young to manifest spike, but where the older trees have already been affected by it, and then to watch the effect of the introduction of these species on the growth of the young sandal. If the sandal establishes root-connections with these new plants, as I have no doubt it will, and remains unaffected by the spike disease, then we shall have not only gained a true insight into the cause of the disease, but shall have also triumphed over it. The results of an experiment like this cannot be gauged without patiently waiting for a few years, but the enormous interest at stake justifies a trial.

11. I have found a sandal forming root connections with other plants such as grasses, herbs and small shrubs, at a very young age, even within a few months of its germination. As it advances in growth, it attacks roots of larger species. These observations go to confirm entirely what has been already recorded by Mr. Barber. With growth, its requirements also increase proportionately; and unless it finds suitable congeners capable of supplying its wants, it languishes, grows stunted and sickly, with its leaves gradually diminishing in size and turning yellow. This accounts for the stunted and sickly appearance of sandal trees in low open scrub on dry stony soils. The failure of sandal plantations in Coorg, Mysore and the Madras Presidency is probably attributable to the same causes. The largest sandal trees on the Salem Javadis are generally found on fairly deep rich soils, with or without stones, and in the company of other species such as *A bizzia odoratissima*, *Albizzia amara*, *Atlantia monophylla*, *Limonia acidissima*, *Premna tomentosa*, *Zizyphus xylopyra*, *Z. œnoplia*, *Poliyalthias*, *Unonas*, *Carissa carandas*, *Acacia cœsia*, *Acacia pennata*, amongst other species, with almost all of which the sandal forms root-connection, and to this circumstance, more than any other, I attribute the vigorous and healthy growth.

12. If I have understood Dr. Butler and Mr. Barber correctly, they have based their opinion that the spike is a contagious or infectious disease, or at any rate that it is communicable from tree to tree by their roots, on the main circumstance that the first invasion of the disease was sudden and extended rapidly over a large tract. May not this be explained by the area thus suddenly affected being completely under the lantana, to the exclusion probably of all other species, and when the roots of the lantana all over the

area and within reach of the sandal roots had been attacked and rendered unfit to furnish nourishment to the sandal, this circumstance being aggravated by fires, the supply of nourishment to the sandal was suddenly cut off and hence resulted the sudden and rapid appearance of the spike over an extensive tract.

13. I have ventured to record the foregoing ideas without any pretensions to have solved the problem which has so far baffled specialists like Dr Butler and Mr. Barber and observers like Mr. Muttannah and Mr McCarthy, but in the simple hope that they may give a clue to the causes of the spike disease; on the other hand, if they be proved erroneous, I shall be glad to know it.

Plains Forests and Underground Waters.

(Observations made in the Forest of Mondon (Meurthe and Moselle)

THE above is the name of an article in the *Revue des Eaux et Forêts* (March and April numbers, 1903,) by M. E. Henri, the celebrated Nancy professor, and the greater part is here roughly translated for the benefit of such readers of the *Indian Forester* as have not the opportunity of seeing it in the original French. It is an example of the really scientific way they study forest problems in foreign countries. In India we do but little to place our work on a scientific basis, and therefore render ourselves liable to the gravest mistakes with very far-reaching consequences. If perchance some individual forester works at a forest problem in the midst of his ordinary multifarious duties, as likely as not the results remain unknown to the bulk of the department. As a rule his ordinary work is as much as an energetic officer can manage. Nor is it sufficient that we in India should sit and wait for the result arrived at by foreign research bureaux, since facts which apply in Europe or America may not apply in India, where the climatic conditions are so vastly different, as M. Henri remarks in a note to this very article, which we will now proceed to translate.

In March 1897, I received from M. Ototsky, Conservator of the Mineralogical Museum of the University of St. Petersburg, a very interesting work giving the results of the hydrological researches made in 1895 in the steppe forests of Southern Russia by the *Société Libre Imperiale Economiqué*, which placed the direction of these researches in M. Ototsky's hands.

These researches are connected with the extensive enquiry that the Russians are at the present time making into the reason for the fall in the level of streams in their country and the greater frequency of years of drought which lead to such terrible famines. The Forest Department is, for its part, organising hydrological tours into the regions where the drying up of the climate and the diminution of running waters have been most complained of. One realises of what capital importance enquiry into the causes of these phenomena is in European Russia, where the rainfall is small

and often insufficient for the satisfactory growth of crops, especially beet and cereals; the rainfall in fact only varies, according to regions and years, between 20 and 60 centimetres, while the Caspian steppes do not even receive 20 centimetres in the year.

NOTE.—The maximum annual rainfall of Russia (60 centimetres) corresponds to the minimum of France, where it is from 60 to 80 centimetres.

The numerous borings made in the forest of Chipoff (in the Government of Voronej) and in the Black Forest in the Government of Kherson, both on the southern border of the region which in Russia is called the forest-clad steppe, have enabled M. Ototsky to formulate the following dictum, which I quote *verbatim* :—

The results of all the observations made in the steppe forests of Southern Russia are as follows :—*All physico-geographic conditions being equal, the level of *phreatic waters in the forests of the steppe zone is lower than in the adjacent steppe or than, speaking generally, in a neighbouring open space.*

The depression of the level is more marked under old than under young forest crops.

Borings made during the season of growth (1st June to 1st September) both inside and outside the forest of Chipoff, show that the water level inside is some ten metres lower than outside, and similarly, in the Black Forest the difference is some four or five metres.

Presumably these figures are maxima, which are only rarely attained, because firstly the boring took place at the moment when the forest is transpiring most, that is, at the moment when it draws the greatest quantity of water from the soil, and secondly, because the experiments were made at places where the annual rainfall is only 30 centimetres, where natural forests are nearly completely wanting, in great part by reason of the lack of water, and where, being nearly always very thirsty, they greedily utilise for their needs of transpiration the meagre provision of water to be obtained from the atmosphere.

The Society desired to study the influence of forests on underground waters in other conditions of soil and climate. In 1897 observations were made again under the direction of M. Ototsky further north in latitude 60°, the former experiments having been made some 10 degrees further south. The bore holes were sunk in the forests of Ondielnaïa and of Pavlosk in the Government of St. Petersburg, where the climate is colder and damper, the rainfall greater and underground waters more abundant. These were fir forests instead of deciduous forests, as at Voronej and Kherson. Here, again, great care was taken to locate the borings in as similar physico-geographical conditions as possible, that is to say on flat ground (of moraine origin) formed of layers of mine-

*This is the term used by Daubree to represent the layer of underground waters nearest the surface which feeds ordinary wells. It seems untranslatable into English.—*Transl.*

ral soil of the same composition and parallel strata, where the level of phreatic waters was motionless.

M. Ototsky came to the following conclusions:—

"In spite of new physico-geographical and climatic conditions (abundant subterranean water close to the surface, a cold and very damp climate, trees with superficial [*fraçantes*] roots, etc.) in the forests of northern Russia, I found the same fact as in the steppes *viz.—throughout the forests that were studied the first layer (horizon) of underground waters is lower than in the neightbouring open country.* This fact was particularly marked in the forest of Ondielnaïa, where underground water was entirely absent. But as a rule, for reasons easily understood, the influence of the northern forests is weaker than in the steppe forests. The difference in level is not more than 0·5 to 1·15 metre, according to the forest."

These results were so much in opposition to the ruling idea that it was urgent to verify them and to see whether different climatic conditions, especially a very much higher rainfall, would modify or reverse the results obtained in Russia.

In July 1899 M. Daubree, Director-General of Forests, sanctioned at my request, a grant of money to enable the Forest School (of Nancy) to experiment on the influence of forests on underground waters in the N.-E. of France, where the rainfall is three times as heavy as in the Governments of Voronej and Kherson.

Situation:—The Government forest of Mondon, near Luneville (Meurthe and Moselle) was chosen for the observations, because it realises most of the requisite conditions. The forest is easily reached, and lies between the rivers Meurthe and Vezouze, being about 2,000 hectares in extent at from 246 to 266 metres above the sea. The nearly level soil is alluvium and is not anywhere more than 30 metres above the river.

Soil:—The soil consists of sand, gravel and pebbles of very unequal size. At the surface it is generally fine sand, red, grey or white; sometimes it is so fine as to resemble a clay soil by its faculty of imbibition; beneath comes the gravel, and then the pebble (quartzite of milky quartz), the soil ever growing damper as the water bearing layer is approached, and the layer not being much more than 5 metres down.

From a boring made on the south border of the forest the impermeable layer upon which the underground sheet of water was supported was found to be 7 metres below the surface.

Climate:—The most important element from our present point of view is rainfall. The depth of the rain water (lame d'eau). which fell on the forest was 713 millimetres in 1900 and 891 in 1901, as shown by a meteorological station at 3 kilometres to the north of the centre of the borings which were taken (see below). In an average year the rainfall is greater from June to December than in the first five months of the year, the measurements (*franche pluviale*) rising to 5 decimetres in the summer and autumn (June

to November) and falling to 3 decimetres in the winter and spring (December to May). The total number of rainy days is 160 to 170.

The mean temperature is 9°4 C.; for the winter 1°43 C.; for the spring 9°05 C.; for the summer 17°7 C.; and for the autumn 9°42 C.

Ten boreholes of 0·05 metre diameter were made with a Belgian geological borer from the spring of 1900 onwards, and tubes of zinc, pierced with small holes and with a similarly pierced cone at the end, were driven in, so that earth could not fall in. The numerous small holes in the tubes easily allowed the water to find its level. Five borings were sunk in open ground, in the areas cleared for the use of the Forest Guards, or in nurseries, or village grazing grounds, but always near the forest, the furthest being no more than 100 metres off. Five other borings, to be compared with the first five, were sunk in the neighbouring forest as near and in conditions as comparable as was practicable. There were thus five pairs of borings, but one pair was spoilt and abandoned. Observations were made once a month from the 4th May 1900 to the 24th August 1904.

Depth to the subterranean water in the four pairs of borings.
(The letter *h* means the elevation).

Dates.	No. 1, open ground (field). h = 243·77 metres.	No. 1 bis. — Wooded ground old coppice. h = 244·58 metres.	No. 2, open ground (nursery of 24 ares). h = 244·53 metres	No. 2, bis.—Wooded ground old coppice. h = 245 metres.	No. 3, open ground (field). h = 257·67 metres.	No. 3 bis.—Wooded ground old coppice. h = 258·87 metres.	No. 4, open ground, grazing land. h = 247·46.	No. 4 bis.—Wooded ground Scots pine. h = 246 metres.	
	Metres.	Metres.	Metres.	Metres.	Metres.	Metres.	Metres		
4-5-1900	2·12	3·31	3·45	...	...	...	2·43	1·30	*Note.*—The figures underlined with a full line show the highest level; those underlined with a dotted line the lowest.
17-6	2·35	3·40	3·65	...	...	...	2·65	1·22	
13-7	2·55	3·50	3·93	...	...	...	2·90	1·44	
16-8	2·70	3·72	4·53	4·89	...	...	...	...	
20-9	2·90	3·90	4·95	5·30	...	5·25	3·30	1·68	
12-10	3·08	4·00	5·00	5·15	3·72	5·32	3·37	1·73	
17-11	3·18	4·10	5·10	5·20	3·75	5·35	3·40	1·76	
18-12	3·12	4·20	4·60	5·17	3·66	5·20	2·90	1·60	
15-1-1901	3·20	4·25	4·85	5·22	3·75	5·20	3·00	1·54	
21-2	3·16	4·25	4·75	5·18	3·58	4·96	borings buried by snow.		
18-3	3·05	4·17	3·85	5·18	2·71	4·36	1·89	0·27	
18-4	2·13	3·65	3·27	4·27	2·39	4·18	1·65	0·28	
14-5	2·28	3·35	3·37	4·09	2·62	4·22	2·23	0·86	

Depth to the subterranean water in the four pairs of borings—(concluded).

Date.	No. 1, open ground (field). h = 248·77 metres.	No. 1 bis. Wooded ground old coppice. h = 244·58 metres.	No. 2, open ground (nursery of 24 ares). h = 244·53 metres.	No. 2, bis.—Wooded ground old coppice. h = 245 metres.	No. 3, open ground (field). h = 257·67 metres.	No. 3, bis.—wooded ground old coppice. h = 258·8 metres.	No. 4, open ground, grazing land. h = 247·46.	No. 4, bis.—Wooded ground Scots pine. h = 246 metres.
	Metres.	Metres	Metres.	Metres.	Metres.	Metres.	Metres	
23-6-1901	2·53	3·58	3·73	4·38	2·85	4·54	2·61	1·23
17-7	2·64	3·70	4·00	4·64	3·20	4·80	2·88	1·50
20-8	2·82	3·90	4·47	4·95	3·35	4·99	2·87	1·52
21-9	2·69	3·98	3·84	5·07	3·07	4·85	2·11	1·05
21-10	2·75	4·02	4·06	5·05	2·97	4·75	2·05	0·85
21-11	2·73	3·90	4·29	5·00	3·07	4·49	2·03	0·74
21-12	2·67	3·85	4·15	4·98	2·80	4·42	1·80	0·52
27-1-1902	2·28	3·72	3·73	4·62	2·58	4·09	0·86	0·37
25-2	2·03	3·28	3·32	4·07	2·19	3·70	0·80	0·27
26-3	2·13	3·25	3·41	4·93	2·91	3·60	0·22	0·35
23-4	1·99	3·25	3·30	3·96	1·95	3·48	1·27	0·52
21-5	1·85	3·23	3·22	3·93	1·72	3·35	0·13	0·20
21-6	2·19	3·25	3·63	3·98	1·81	3·54	1·50	0·65
22-7	2·66	3·49	3·68	4·30	2·35	4·15	2·54	1·20
24-8	2·71	3·67	4·12	4·64	2·80	4·62	2·89	1·49
Mean for the 28 * months.	2·59	3·69	4·06	4·69	2·82	4·44	2·16	1·01
	+1·10		+0·63		+1·62		—1·15	
And taking account of the difference in elevation of the orifices in each pair of borings, the mean becomes.	3·39	3·69	4·49	4·69	4·02	4·44	2·16	2·47
Under forest the level is lower by maximum difference.	+0·30		+0·20		+0·42		+·031	
	1·35	1·05	1·73	1·27	2·03	2·03	3·27	1·56

* *Note.*—From this point to the end of the table it is not understood how the figures were arrived at. Apparently they should be as follows:—

2·59	3·71	4·01	4·73	2·86	4·47	2·16	1·01
+1·12		+0·72		+1·61		−1·15	
3·40	3·71	4·48	4·73	4·16	4·47	2·16	2·47
+·31		+0·25		+0·31		+0·31	
1·35	1·02	1·88	1·34	2·03	·00	3·27	1·56

DISTANCES AND ELEVATION OF THE BORINGS.

1st Pair.—No. 1 in the centre of a square of about 8 hectares, cleared of forest for the fields of a Ranger and a Forest Guard living at a forest house and No. 1 bis. about 300 metres distant from No. 1, in a coppice coupe with a considerable number of standards. The difference in elevation being 0·81 metre, which must be added to No. 1 if it is desired to reduce the two borings to one plane.

2nd Pair.—It comprises the boring No. 2 represented by the well, which is in a small nursery of 24 ares in extent and No. 2 bis. in a 50-year old coppice: at about 100 metres from the well its orifice is 0·47 metre higher than that of the well. No. 2 bis. is only about 20 metres outside the forest. In spite of the smallness of this open place the absence of forest growth already affects the water level, more, even, than the table would appear to show. It is a known fact that round a well the layer of water is bent, the well exercising a sort of suction. The true level is higher than the surface of the water in the well, of which we have only measured the variation. It is doubtless for this reason that the difference in level (*dénivellation*) is less here than in other pairs of borings.

3rd Pair.—No. 3 in the centre of an area about one hectare in extent, being the open ground near a Forest Guard's house and No. 3 bis. in a coppice of 30 to 35 years age with a considerable number of standards. The distance apart was 900 metres; the difference in elevation 1·30 metres.

4th Pair.—No. 4 in uncultivated grazing land, higher by 1·46 metres than No. 4 bis. and 650 metres from it. No. 4 bis. was in very thick sapling forest 30 years old, consisting almost entirely of Scots pine. The soil was covered with a thick layer of needles, more or less decomposed.

The tubes are still in the ground, so that should there be any cases of extraordinary climatic conditions it will be possible, and may be very useful, to take measurements again.

(*To be continued.*)

A Protest from the Malay States.

WITH reference to Mr. Gamble's article on "Certain important forest questions" in the *Indian Forester* for November (No. 11) page 489, in which he discusses the qualifications of Burma as a training school in the preparation of Forest Officers for higher appointments, and makes certain statements affecting the nature of the works in Burma, I would ask to be allowed as a Burma Forest Officer of 13 years' standing to question some of those statements and state some facts. The writer is apparently ignorant of the actual state of affairs in Burma with regard to the more important works or has been misinformed.

Firstly, Mr. Gamble asks, "What works have been done in those reserves where taungyas are not cut and where the constant extraction of teak *must* be impoverishing the capital of the forest and encouraging the growth of the less valuable species." The general rule in Burma is that where no detailed working-plans have been drawn up for a reserve, no teak trees may be felled. A glance at the Review of Forest Administration in British India for 1901-1902 will show that 2,196 square miles are under sanctioned working-plans, and naturally those plans are so drawn up that far from impoverishing the forests they will be richer in teak at the end of the first period than they are now. My own experience of Burma embraces the Rangoon, Toungoo, Prome, Magwe and Minbu, Upper Chindwin and Pyinmana Divisions. In Rangoon and Magwe at that time there was no sanctioned working-plan, therefore no cutting of teak was permitted; in Prome working-plans were made for all the teak forests, and as I was in charge for three years and did girdling work myself, I can testify that if anything we are taking out less than the normal yield of teak. In Toungoo I was engaged on working-plans for one cold season, and I believe that at the present moment the field work for the whole of the Toungoo teak reserves (about 1,000 square miles) is now completed. In Tharrawaddy, as is well known, all the teak cut in reserves is girdled under a sanctioned working-plan, and the out-put, although very large, is regular and cannot diminish unless through difficulty of extraction.

I fail to see how teak "taungya" plantations affect the matter at all, *as they will yield us no return within the next* 100 years.

I feel sure that I am safe in saying that since the girdling of teak trees by Messrs. The Bombay Burma Trading Corporation, Limited, was put a stop to by Government, no girdling has been done such as would warrant the assertion that the teak forests are being impoverished. Such a statement would obviously reflect on the Burma Forest staff as well as on the Inspector-General of Forests. In all girdling of teak at the time I speak of, every tree in reserved forests was selected, measured and marked by an Assistant Conservator, or Extra Assistant Conservator of Forests; and on no account could the number laid down in the working-plan for girdling be exceeded.

In addition to this, special girdling proposals were sent in yearly to the Conservator as a double safeguard. As regards "the encouraging of less valuable species" mentioned by Mr. Gamble, a glance at the provision of any of the working-plans for Tharrawaddy, Toungoo, Prome, etc., will show that due provision is made for the execution of works of improvement, chiefly creeper cutting and freeing of young and suppressed teak trees by felling or ringing less valuable species. I had personally to inspect such works regularly, and in any compartment girdled over in any one year such works were carried out prior to girdling. The areas so treated are very large, exceeding in some divisions 5,000 acres per annum.

As regards the alleged falling off of teak supplied from Burma, this has obviously no connection with excessive cutting, at any rate for the last few years, seeing that forests for which no working-plans exist are closed to extraction, and that year by year as working-plans are drawn up more and more forest is opened up to systematic felling. The quantity of teak cut annually should therefore gradually increase. A falling off as compared with the out-put of some years ago is accounted for by the fact that the Bombay Burma leases have mostly lapsed, and that they have, as is well known, removed two-thirds or more of their employees and elephants to Siam. Reference to para. 31 of the Inspector-General's Review for 1901-1902 further explains the poor outturn for that year in Burma, *viz* :—"Unfavourable seasons, closing the waterways prematurely." I think I have said enough on this head to convince such as require convincing that this main principle *of forestry is not being neglected in Burma, but if not I* can only suggest a careful study of the subject and a tour through one or two Burma divisions.

I have only a few words to say as regards Mr. Gamble's opinion as expressed on pages 490 and 491, in which he evidently considers that a Burma Forest Officer's greatest object is the production of revenue, and that demarcation and other works are not given all the attention that is their due. I can assure him

that my own experience and that of the men of about my own length of service, besides many others, has been quite the contrary. To quote from personal experience, my first year in Burma was enployed in demarcation and marking out of Cutch reserves. I had to demarcate practically all the forest reserves in Magwe sub-division, several hundred square miles reserves proposed a year or two earlier by Mr. C. W. A. Bruce. Knowing the Magwe forests as I now do, I can say they could not have been better chosen.

In the Upper Chindwin I was employed for two years on no other work. The first cold season on demarcation for two months and then survey and reserve proposals and settlements. In my second cold weather I spent five months choosing reserves in new country, and was able to send in proposals for 250 square miles of reserved forest with plane-tabled boundaries and valuation surveys. In Prome, which I afterwards held for three years, the works were such as a Forest Officer might almost consider ideal for teaching and learning forest work, and I will enumerate them and leave the reader to judge.

1. Regular girdling as per working-plans over about seven compartments annually, in area about 700--800 acres each.
2. Works of improvement in the same.
3. Fire protection over 100 square miles.
4. Teak taungya plantations.
5. Cutch do. do.
6. Thinnings of plantations.
7. Weeding of plantations.
8. Selection of new reserves (probable area 300 square miles).

And lastly, but also very important, the extraction of about 5,000 logs of teak annually by Government agency, necessitating the making of about 24 contracts with local Burmans, the handling of large sums of money in advances, and the portioning out of such areas as were available and had been girdled as per plans.

As regards forest protection, offences were extremely numerous and the amount of work in this line was very heavy.

I would here again draw attention to the remarks of the Inspector-General of Forests in his Report for 1901-1902.

Section II.—Forest Settlement.
" III.—Demarcation.
" IV.—Surveys, concluding para. (para 8).
" V.—Working-plans (para. 10) Burma.

In every case the Inspector-General makes mention of the large amount of good work done, and I think his remarks carry, if possible, extra weight when it is remembered that he came straight from Burma to take up his officiating appointment. There is one point however on which I have great pleasure in endorsing the opinion of Mr. Gamble, and that is as regards buildings and communications, and here I must, on behalf of the average Forest Officer, disclaim all responsibility. It is not permissible to

criticise the powers that be, even if they have an undue lust for a large surplus, but I am sure that the Forest Officers of Burma would agree that more should be spent on roads and buildings, or rather bridle tracks and fords, as the area is too vast to attempt roads on a large scale. At the same time the expenditure on buildings for Burma in 1901-1902 was greater than that in any other province except one. The rivers of Burma will always be the main lines of transport for teak however, and money judiciously spent on their clearance is well spent.

It is for timbers such as Pyinkado that roads or tramways will be required.

In conclusion I may say that I am two years behind the time as regards actual experience in Burma, as I have been serving now for two years in the Federated Malay States and Straits Settlements, but I maintain that no finer all-round training ground for a forester can be found than *Burma*, provided experience is obtained both in Upper and Lower Burma.

I anticipate, Mr. Editor, that many more able defenders than myself will have arisen, but at any rate I have tried to give you my personal experience as a Burma Forest Officer. I believe it will stand as a fair average sample. Mr. Gamble has, at any rate, succeeded in arousing my sense of justice, and he alone must be held responsible for this long and perhaps wearisome history, much of it I fear my own personal history. Situated as I am at the moment on tour in these States, I have but little in the way of reference, and the only facts I can rely on are those for which I can vouch by personal experience.

A. M. BURN-MURDOCH, I.F.S.,

Chief Forest Officer,
Federated Malay States and S.S.

The Use and Abuse of Forest Work in Burma.

IN the November number of the *Indian Forester*, an article appeared by Mr. Gamble in which he makes an attack on the forest administration of Burma—on attack the seriousness of which is at once discounted by the obvious ignorance of the writer of his subject.

Mr. Gamble's personal acquiantance with Burma dates back from over 30 years ago. When newly arrived from Europe he spent about half a year there.

If Burma really were as backward as Mr. Gamble would have us believe, there would be some excuse for it to be found in the fact that it is still a young province, and that forest administration over the greater part of it has not yet existed for 20 years.

It is to be supposed that Mr. Gamble would distrust any figures quoted from annual administration reports to show the real and rapid development of the country, as being more indicative

of overworking the forests and of sacrificing everything to revenue, than of any legitimate expansion; yet any one who has spent any time in the country knows how real and rapid this growth is, resulting in changes which cannot fail to be noticed, not only decade by decade, but year by year

Mr. Gamble's first point is that in Burma forest conservation and sylviculture are subordinated to revenue making.

No justification of this opinion is given, and it is difficult to guess on what it is based.

It is certainly not the opinion of the vast majority of men who have spent most of their service there.

In to-day's issue of the *Pioneer*. (12th November 1903) there is a leading article in which it is stated that so far from any over-working of the forests being the case, there is a general complaint being made by the timber traders against the present *under working* of the forests of Burma.

It is to be remembered that the conditions in Burma differ considerably from those of Northern India. In Burma the whole country is practically jungle, and cultivations and private lands occupy a very small proportion of the whole area of the country, so that instead of having huge expanses of cultivated and private lands, with comparatively small areas of forest, in which every stick and every bundle of grass has its value, we have in Burma vast areas of forest side by side with a very small agricultural population and a very restricted area of land under cultivation; moreover, in these forests there is generally only the one species, teak, which pays for its cost of extraction and export, and this species only forms from one-tenth to one-hundredth of the entire stock, so that cultural operations, and extensive works of improvement, are generally not only unnecessary, but actually impossible.

It is certainly surprising to read Mr. Gamble's emphatic assertion that the extraction of the only valuable species out of a mixed crop *must* necessarily diminish the proportion of this species in the crop. If this were so, why has not all the deodar disappeared long ago from the less remote of the Himalayan forests? Does Mr. Gamble seriously mean that teak can only be perpetuated in the forests of Burma by means of taungya plantations?

In forests of this kind, provided that the yield is placed at something less than the annual production of trees of exploitable dimensions of the one valuable species, and that only trees which have reached maturity, or which have advance growth beneath and around them ready to take their place, or trees which are not required as seed-bearers, are felled, the proportion of the valuable species may be not only maintained, but actually increased in the forest.

Sir Dietrich Brandis, to whom Mr. Gamble slightingly refers as the "old Forester," claiming to have started the Department,

did not mean to refer to any subordination of sylviculture to revenue making when he brought forward the fact of the net forest revenue of Burma being greater than that of all the other provinces of India put together.

There can be no doubt that he merely wished to indicate the vast area of forest in Burma, and its value and importance as shown by the net annual revenue, which may very fairly be taken as a criterion for comparing the extent and importance of the forests of one province with those of others. An Inspector-General who knew nothing of the Burma forests, and the very different conditions which obtain in this province, would certainly be ill-equipped for his work.

Mr. Gamble is evidently determined to find no good thing in Burma. Everything is bad.

As regards the taking up of reserves, a work which Mr. Gamble states to be in a very backward state, the yearly rate of extension for many years past has been over 1,000 square miles, and the work of selecting fresh areas for reservation is now almost completed. It is only in the remoter parts of Upper Burma that the undermanning of the staff has prevented this work being carried through.

Demarcation in Burma is not carried out on quite the same line as in Northern India, but it is quite efficient, considering the vast areas to be demarcated, the scanty population of the country and the absence, as a rule, of any friction between cultivators and the guardians of the forests.

If there is one point more than another in which the work of the administration of Burma can compare favourably with that of any other province it is the forest settlements. So far from being bad and backward, as Mr. Gamble says, they are generally better done, sounder and more accurate, both from a practical as well as from a technical point of view, than most settlements in other parts of India.

As regards working-plans too, in spite of Mr. Gamble's sweeping denunciation of them, Burma is not really in at all a backward state. It is true that teak forests only require plans of great simplicity, which offer but little scope to the enterprising amenagist, yet for all that the working-plans in Burma are efficient and practical, safeguarding both the protection and improvement of the crops as well as the regularity of yield, and the only reason why they have not yet been prepared for all the forests in the province lies in the simple fact of scarcity of available officers.

Mr. Gamble declares that of roads in Burma there are "practically none." In Burma there is very little export of timber by road, and forest roads are consequently not so important as they are in other provinces, but still, though one cannot drive round all the forests in a dogcart, it is childish to say that there are no roads.

Houses, too, though Mr. Gamble says that they are "hardly started," are to be found in all divisions, not only at headquarters, but wherever required along most of the roads frequented by Forest Officers, and at all the principal centres of works of felling and extraction, plantations, fire-protection, etc.

The houses are not *pakka*, it is true, but they are of the ordinary style used by the P. W. D. and other departments in Burma, and are quite sufficient.

To say that little is known or done in Burma as regards planting, and that the arrangements for extracting timber are defective, shows an ignorance of facts only equalled by the astonishing assumption that the Government of Burma are deliberately and systematically ruining the forests by overworking them.

BURMAN.

Ceylon Forest Report for 1902.

THE Ceylon report this year is by Mr. A. Clark who acted as Conservator for part of the period between the departure of Mr. Brown for the Soudan and the arrival of Mr. Pigot from Assam. The forests still continue to be under the charge partly of the Government agents and partly of Assistant Conservators. It is presumed this arrangement is continued for financial reasons and on account of the paucity of superior officers in the Department. The financial side of a question is always an important one, especially in a province where the forests of two of the circles are managed at a heavy loss, but it would seem imperative on all grounds to have a Departmental Officer in charge of the Southern Division, which provides the largest surplus this year, *viz.*, Rs.32,306, and the forests of which are worked by a Forest Ranger on Rs.60 a month, under the orders of the Government Agent.

The area of reserved forest at the close of the year was 687 square miles, of which 253 square miles were added during the year. Proposed forests amounted to 1,272 square miles and "other" forests to 10,710 square miles. These figures indicate abundant scope for energy for some years to come in pushing on forest settlement work. A definite settlement programme, showing the areas proposed to be reserved and the ultimate total area of reserved forest in each division, would be a great help. The work of demarcating boundaries was only taken up some two or three years ago. 293,000 chains of boundary have now been demarcated, including 25,000 done during the year under report. The total amount spent on demarcation has been Rs.1,13,227, and the Conservator appears to consider the money might have been better spent, remarking that—

"There are now many hundreds of miles of boundary lines, the larger portion cut through wild uninhabited country and demarcating forests which are not likely to be taken up for systematic working for many years to come. If these lines are not attended to, they will in a few years become overgrown and obliterated. The cost of re-clearing will be very heavy and ever increasing, and is likely to become in time an intolerable burden on the Department."

No working-plans were attempted, but information for the preparation of the same was collected by means of enumeration surveys and the formation of sample plots. Among other trees measured in the sample plots were satinwood and ebony, and the figures for satinwood show that the number of years which it would take for a tree to increase from 9 inches to 6 feet girth varied according to locality from 87 to 177 years, while for ebony it varied from 90 to 186 years.

Systematic fire-protection does not exist, nor is any return given of the area burnt over during the year. One Assistant Conservator reports the fires to have been very disastrous in their effects, and expresses the opinion that "unless very stringent measures are taken to prevent this utter destruction of valuable forests, these forests will be exterminated." The Conservator's comment on this opinion is that "such a fate may happily be regarded as rather remote." Remote it may be, but an early attempt at fire-protection would appear indicated. We gather that forest offences were rife in many districts, illicit felling of timber and illegal mining and cultivating were the most common. The two latter are not likely to decrease until the forests are demarcated thoroughly and the boundaries efficiently maintained in spite of their being a drag on the department.

Natural reproduction suffered from the abnormally heavy rainfall which took place during the last four months of the year. Flowers, fruit and seed all suffered, with a consequent diminution in the seedling crop. Over Rs. 10,000 was spent during the year on plantations, of which there is a total area of 1,291 acres. In

the Western Province it was proposed to start a plantation for railway fuel, but its commencement was deferred as the financial prospects of the work were not good. Experience in India has repeatedly shown that railway fuel plantations on a small scale are not a success. They are expensive to make and their upkeep and protection are so costly that the cost of fuel from them when ready for cutting is too high for the railway to pay, with the result that it goes elsewhere for its wood or burns coal.

Rupees 6,100 were spent on buildings during the year, and Rs.2,923 represents the very inadequate outlay on communications.

Timber to the value of Rs. 243,877 and firewood to the value of Rs.77,632 were sold by the department during the year. The material was either collected departmentally or removed under payment of royalty.

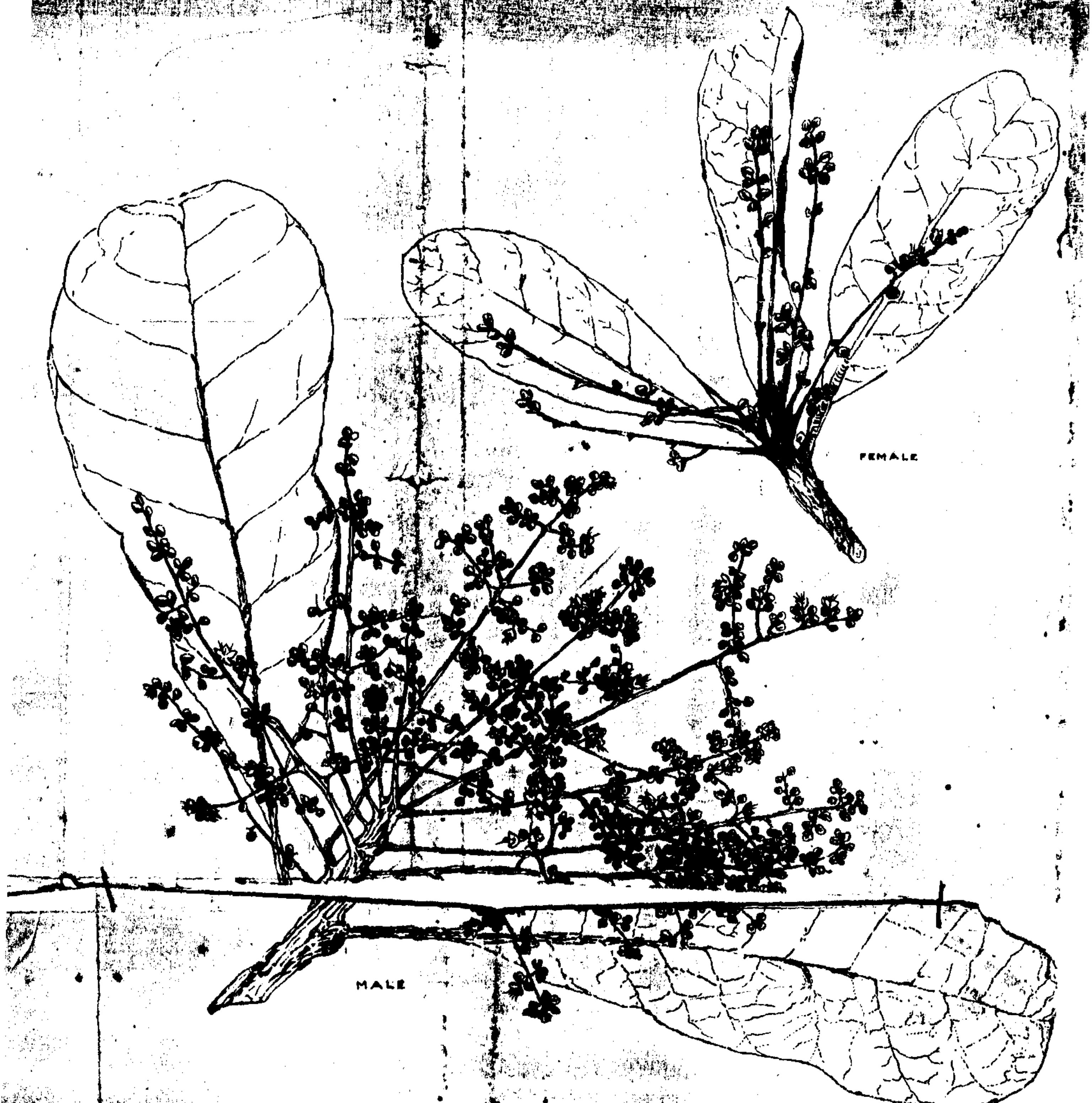
The prosperity of the department depends mainly on sales at the Central Timber Depôt, Colombo, and to keep this supplied with timber forests are ransacked for first class trees even in remote parts of the Island. Little or no attempt is made, except in the Eastern and North-eastern Circles, to confine fellings to certain forests and to work through them systematically, "taking the lean with the fat" year by year. There are great numbers of trees the timber of which is sound and durable, but which cannot be sold in the log on account of their small size, but which if sawn up would yield first class building material. The Northern Railway, when completed, will open up forests containing quantities of such second class trees, the timber of which, if sawn up and conveyed at cheap rates to Colombo, would doubtless realize fair prices.

The financial results of the year's working were as follows:—

		Rs.
Receipts	... ...	3,60,261
Charges	... ...	2,68,591
Surplus	...	91,670

This surplus shows a decrease of Rs. 14,600 on that of the previous year, and may be explained by the extraordinary decrease in the value of timber supplied to the Public Works Department. In 1898 the value of the timber supplied was Rs. 2,77,316, and it has diminished regularly each year until in 1901 it only amounted to Rs. 76,161 and in the year under report to Rs. 38,077.

PLATE I.



M. M. Bourdillon delt.

HOLIGARNA NIGRA, BOURDILLON

A. P. Cortez & Co. Lith

THE INDIAN FORESTER.

VOL. XXX] MARCH, 1904 [No. 3.

Holigarna nigra: A new Species communicated by J. F. Bourdillon, F.L.S.

ANACARDIACEÆ.

Holigarna nigra, sp. nov.

Leaves 3—6in. by 1—2½in., simple, alternate, entire, spathulate, dark green, very coriaceous, with 6—9 pairs of prominent secondary nerves. *Petiole* ½—1¼in. with 2 or 4 spur-like appendages. *Flowers*—diœcious, in terminal and axillary racemes and panicles, up to 12in. long in the case of the male flowers and about 3in. long in the female. Male flowers ⅛in. across, female rather larger, all on very short pedicles. Petals 5, white, clothed with white hairs, calyx black villous. Stamens 5, white, with black globose anthers. Ovary 1-celled. Styles 3—5. Drupe not seen.

A large evergreen tree occurring in the forests of Travancore between 2,000—4,000 feet; height 100 feet, diameter 2 feet; flowers in April.

Bark smooth, grey, ¼in. thick. Juice black. Wood very soft, coarse and open-grained, greyish-white. Pores large and scanty. Medullary rays fine and close together. No annual rings.

Weight = 31lbs., P. = 408.

The wood is useless, nor does the tree appear to have any valuable properties.

This tree differs from *H. Arnottiana* by its smaller leaves, more slender panicles, and its sooty flowers. The two species are never found together, *H. nigra* occurring on the hills and *H. Arnottiana* being confined to the low country. [See Brandis' *Indian Trees*, p. 203.]

Suggestions regarding Local Forest Floras.

By R. S. Hole, F. C. H., F.E.S.

In the November number of the *Indian Forester*, Vol. XXIX, Mr. Gamble remarks, "I well remember the secret feeling of despair which I had when in 1872 I was sent to work in a region of many trees very little known. *There were* no "Forest Floras" no *Flora of British India*, no lists with

native and scientific names, and except one or two kinds, nobody knew which trees had good timbers, which worthless ones, what kinds were useful for building, which for fuel, what for valuable minor products, and so on." In the thirty odd years which have passed since then, a vast deal has been done towards helping Forest Officers to know their trees, more particularly by the *Forest Flora of the North West and Central India* by Sir D. Brandis and the *Manual of Indian Timbers* by Mr. Gamble, while the book which Sir D. Brandis is now preparing will do a great deal more. At the same time a great deal still remains to be done, and no time is to be lost if the present generation of Forest Officers is to show itself worthy of its great predecessors in the Department, if it is to obtain the full benefit of the work done by these great pioneers, if it is to carry on and extend what has been so splendidly begun.

2. There are, for instance, species of considerable local interest and importance in the areas where they are found, but which are not of sufficient general interest to warrant their inclusion in works of the scope of those quoted above. There is also a quantity of information regarding species which are mentioned in these books, which, although it is of the greatest utility to the Forest Officer in the locality to which it particularly refers, cannot be included in any one general work, owing to the exigencies of space and also because of the fact that, even if it were so included, it would be practically useless, owing to its being obscured and hidden by a mass of other information which is of more general importance. In other words, the great books of Sir D. Brandis and Mr. Gamble occupy very much the same position with regard to the Forest Department as does Sir T. Hooper's *Flora of British India* with regard to the general public, *i.e.* they are intended "to facilitate the compilation of local Indian Floras."

3. It is also now recognized that it is necessary not only for the officers belonging to the higher grades of the Service, but also for our subordinates, to have an intimate knowledge of the more important plants which compose the immense and varied forests in our charge, and, with this object, the students of the Imperial Forest School are taught to know and take an intelligent interest in the trees and shrubs which they see around them, during their course of training at Dehra Dun—a task which is now made easy through the existence of the excellent little *Forest Flora of the School Circle, N.-W. P.* by Kanjilal. This volume is priced at Rs. 1-8 and is therefore well within the means of all our English speaking subordinates. Works with the scope of those of Sir D. Brandis and Mr. Gamble, exceedingly moderate in price though they are, cannot possibly be produced at the same figure as can small local "Floras." It is obviously, also, of the utmost importance that the students after leaving the Forest School should find local "Floras" available in the various districts to which they may be

posted, which will encourage and help them to keep up and extend the knowledge gained at the school. Failing this, their excellent course of training loses much of its utility.

4. When any of us are now sent to a forest region of which we have little or no personal knowledge, although happily we are, in great part at least, free from the feeling of despair which assailed Mr. Gamble in 1872, still there are numerous questions of importance which we at once begin to ask ourselves, to which the answers are not readily forthcoming. In some cases the information we seek is contained in books and official records, but we cannot readily discover it; in many cases, although it is well known to several Forest Officers, who have spent some years in the locality, it is nowhere placed on record, and in some cases the answers to our questions are still unknown. We find species of local interest and importance which we cannot quickly and satisfactorily determine; we still find it difficult to make even a good guess at the identity of a tree or shrub, unless we have fairly complete specimens of leaf, flower and fruit, the collection of which is troublesome and takes time; we still find it difficult to quickly "run down" and name a piece of some unfamiliar wood which is put into our hands; and finally, when we come to the sylvicultural requirements and characteristics of the various species met with, we find the greatest difficulty of all in discovering what we want to know. What we need to help us is a good "Forest Flora" which will quickly and easily enable us to acquire an intimate knowledge of the various species which compose our forests and of their relations to one another, in the particular locality with which we are concerned. The work of pushing on the preparation of such "Floras" is then one the urgency of which will, I think, be readily recognized by all.

5. We must now consider the question of the material which should be included in such "Floras." They should obviously open with an Introduction, containing a description of the locality dealt with, its climate, geology and principal kinds of soil, an account of the various types of forest vegetation met with, accompanied by a map to show their distribution, and a short description of the past and present systems of management.

6. The very important question of the sylvicultural notes to be included regarding the principal species next claims attention. A great deal of information under this head is stored in the books of Sir D. Brandis and Mr. Gamble, in the pages of the *Indian Forester* and elsewhere, and a great deal more is known to practical Forest Officers, who have had some years' experience in the forests of any one locality, which knowledge is constantly utilized and applied by them in their work. We now require to collect all this material in an easily accessible form and in such a way that it shall be of the greatest practical use. It is as well to first get an idea of kind of details we are most

likely to need. Many of our forests are now worked under a system of coppice-with-standards, and we do not need to stretch our imagination to suppose ourselves being required to supervise a coppice felling shortly after our arrival in a new locality. As we look at the assemblage of plants before us, the following are some of the questions which we at once begin to ask:—

(1) Which species are light demanders and which are shade-bearers?

(2) Which species, being frost-tender, require shelter and which do not?

(3) Which species grow fastest during youth and are likely to oust the others if left to themselves?

(4) Which species reproduce best by root-suckers and which by stool shoots?

(5) In which species does the power of reproduction from the stool cease at an early age, and in which species does this continue, unimpaired, till late in life?

(6) Which species reproduce best from seed and are most suitable standards for seed-bearers?

(7) Which species are the best to leave as standards with the object of shading and protecting the soil from sun and air currents?

(8) Which species retain their leaves through the winter and are most useful nurses with regard to frost injury?

In other words, we recognize at once that the practical Forester must consider the association of plants which compose his forests *as a whole*, and the characteristics of each species, not separately by themselves, as if the plant was an isolated individual, but in their relation to and effect upon the characteristics of the neighbouring plants, all of which combine together to form the forest. What we mainly require then are, clearly, concise *lists*, in which the principal species are arranged in order according to their relative powers in the above and other respects. We at once think of the excellent lists in Dr. Schlich's *Manual of Forestry*, and we look in vain for similar lists applicable to the forests of the class we see before us.

The sylvicultural notes referring to each species might be separately grouped together under the description of that species. It is, however, I believe advisable to confine the details, in these individual descriptions, as far as possible to those which are likely to be useful in helping us to identify the species quickly.

The addition of the sylvicultural notes would be apt to confuse these descriptions and render them unwieldy, besides which we should then lose the immense advantage of the lists, which enable us to see and compare at a glance the sylvicultural qualities of the various species.

Such lists then must be prepared and should find a place in the Introduction.

Among the lists which would probably be most useful are the following:

(1) Ruling and dependent species.

(2) Species which are most and least exacting in the matter of depth and porosity of soil and of moisture in the soil.

(3) Species which protect and improve the soil and those which do not.

(4) Frost hardy and tender species.

(5) Light demanding and shade bearing species.

(6) Species which attain the greatest height, and least.

(7) Species which grow fastest and slowest during youth.

(8) Species which reproduce best from seed and *vice versâ*.

(9) Species which maintain the power of reproduction from the stool until late in life, and those which do not.

(10) Species which produce chiefly stool-shoots and root-suckers, respectively.

7. It may be objected that these sylvicultural details should find a place rather in a "Manual of Sylviculture" than in a "Local Flora." The obvious answer is that as yet we have not sufficient data for the preparation of complete and practical "Manuals" of this description, and the details in these "Floras," absolutely essential also as they are for an intimate knowledge of the species, will in a great measure supply this want of information and make the preparation of such books possible when it may seem necessary. At the same time such "Manuals" cannot take the place of these "Local Floras," for the former will almost certainly be of more general application and of wider scope than the latter, and in consequence will be of less practical use to a local officer, for they will necessarily omit much useful detail altogether and obscure still more by placing it in the midst of a lot of information which is quite inapplicable to the locality.

Others may say that it has been the aim of Forest Officers for many years past to prepare such lists as the above, and that we have not sufficient data to enable us to make them now.

I feel sure however that far more is known in this respect than is commonly believed to be the case, and that most Divisional Officers who have had some years' experience of a locality could, in a short time, furnish very serviceable lists for their Divisions, and from these, if necessary, a list could be prepared for each Conservator's circle, or, in some cases, perhaps for two or more circles.

Another consideration which appears to have prevented, to some extent at least, any real progress in this direction up to date, is the existence of considerable differences in the opinions of individual Forest Officers on various important points, and any effort to reconcile these differences and to draw up a statement of important principles, which would be generally accepted as true, has appeared to be so beset with difficulties that it has not been attempted. Many of these differences, however, are almost

certainly more imaginary than real, and many of them could be reconciled if fuller details were known of the facts in each case. In other cases, the different observations recorded about one and the same species are undoubtedly caused by the great variations in climate and other local conditions to which one species may be subjected in India, and the effect of which on individual species is very little known. Finally, it must be remembered that we can never expect complete agreement, for Dr. Schlich, in his *Manual of Forestry*, when giving his scale of light-demanders and shade-bearers, remarks, "Scales have been prepared by various authors, which, though agreeing on the main points, *differ somewhat in detail*" (the italics being mine).

At all events there can be no doubt that the sooner a beginning is made, the sooner shall we have correct and useful lists.

8. Every Forest Officer ought to be able to recognize the wood of any species in his forests which is of economic value, or is likely to be found in use. To help him to do this and to enable him to at once find out the name of any piece of wood he does not recognize, a key to the principal woods must be available, by means of which specimens can be readily "run down" and determined. In the introduction to the new edition of his *Manual of Indian Timbers*. Mr. Gamble gives the reasons which induced him to omit such a key from his book, and he observes, "Consequently, in my opinion, local keys would be much more useful than a general one, and need only take in a few kinds of wood." Such a key, he also remarks, "would not be difficult to make." No more suitable place could be found for such a key than a "Local Forest Flora," the object of which is to give as complete a knowledge as possible of the trees, shrubs and important plants which compose our forests, and it would conveniently come at the end of the Introduction.

9. And here I would urge the necessity of having a set of hand specimens of all the important woods found in each circle, prepared and deposited for reference in the Conservator's office and in each Divisional office of that circle.

Owing to the scarcity of such collections, many Divisional Officers, who frequently have little time or opportunity for collecting such specimens, know little or nothing about their woods.

Such collections, also, would help those who have been trained at Dehra Dun, where they have had the advantage of handling the splendid collection of wood specimens contained in the Museum of the Imperial Forest School, to keep up their training in after years, in default of which aid there can be little doubt that much of the school instruction is rendered abortive.

Finally, there is no doubt that a knowledge of woods is a branch of the scientific Forester's training which appeals to, and

is understood by, the outside public, and therefore is one which we cannot afford to neglect if, in the words of Mr. Gamble, "the Indian Forest Department is to preserve its prestige."

10. Following the Introduction, our "Flora" must contain a Glossary of Botanical Terms and then a Key to the Natural Orders. These call for no remarks beyond this, that although a key to the Orders may be inadvisable in a general work of large scope, it is of the utmost use in a "Local Flora," which refers to a comparatively small and limited area.

11. We now come to the question of the species which should be included. All trees, shrubs and climbers should be included as *primâ facie* of importance to Forest Officers, now or in the future. Secondly, all species which are of considerable economic importance must be included, even if they are herbaceous. Thus the economic importance of several species of *Dioscorea*, which are of such immense importance as a food in times of famine, is, in itself alone, quite sufficient to warrant their inclusion, even if they were not also climbers.

Lastly, I believe it is advisable to include those trees, shrubs and climbers which are commonly planted in avenues and cultivated in gardens. Such species are often of considerable economic value and botanical interest, but, apart from this, these are the species which are most familiar to the "man in the street," and although, with lordly indifference, we may say that we do not pretend to be gardeners, etc., still the fact remains that it is not a good thing for the prestige of the Department when a Forest Officer has to be told the name of a common garden shrub or avenue tree by a civilian, or a military man, or, as I once saw to be the case, by a District Superintendent of Police who, bye-the-bye, possessed and studied the *Forest Flora of N.-W. and Central India*.

The little knowledge required in order to become acquainted with such plants is easily and quickly acquired, and is both interesting and useful.

12. Immediately after the name of each species, references should be made to the *Flora of British India* by Sir T Hooker, to the *Flora of N.-W. and Central India* by Sir D. Brandis, to the *Manual of Indian Timbers* by Mr. Gamble, and, finally, to the new book which we soon expect from Sir D. Brandis. Those who then wish to refer to additional information regarding the species, which it has not been thought advisable to include in the "Local Flora", can easily do so by consulting these books and if necessary others which are referred to in them.

13. Following the references will come the vernacular name. In the Introduction to the new edition of the *Manual of Indian Timbers* Mr. Gamble remarks, "To a Forest Officer with some knowledge of botany and capable of verifying descriptions, a vernacular name may often be useful as helping him to trace quickly the scientific name of a plant met with; but to adopt

scientific equivalents blindly, merely on the strength of a vernacular name given by an often inaccurate native, is a practice which may lead, and to my own knowledge often has led, to absurd mistakes." With this proviso, *viz.* that they must be accepted and used with caution, there can be no doubt that vernacular names are of very great value in helping one to quickly identify a plant and to discover all that is locally known about it, by conversing with the local natives. There appears to be a tendency nowadays to minimize the importance of vernacular names, and, curiously enough, this is often particularly the case with the educated native classes, among which trained native Forest Officers must be included. I believe this to be a great mistake, and feel sure that this mistrust of vernacular names has been, in many cases, caused by insufficient care being taken to record the names correctly.

14. In the first place, errors are apt to creep in in the spelling of the names. A vernacular name, to be of practical use in any locality, must be spelt exactly as it is pronounced by the natives of that region who use the name, even though the student of etymology may tell us that such names are obvious corruptions, or vulgarisms. It is not, I believe, an unknown thing for the spelling of a vernacular name to be so altered by the philological specialist as to become unrecognizable to the natives who use the name, and therefore entirely useless for our purpose.

Hence, we must endeavour to commit the names to paper exactly as they are pronounced. Here we are met by the difficulty that the ear of the European does not quickly or easily catch the exact sound of a vernacular name when pronounced by a native. As far as possible, when Divisional Officer, I used to keep a literate native with me in the forests. Each vernacular name, after being repeated several times, was then written down on the spot in vernacular by this native and myself independently. If the spelling disagreed, and, after further repetitions of the name, we could not come to an agreement, both methods of spelling were recorded, until further inquiries enabled me to decide which should be adopted.

Of course, no name can in any case be accepted until numerous independent verifications have shown it to be not only correct, but also one which is commonly met with and therefore likely to be of use. Once the vernacular spelling has been finally accepted, the name must be transliterated into English according to a generally recognized system of English equivalents.

15. As noted by Mr. Gamble, a native who does not know the correct name of a plant will often invent one for the occasion, but after some practice a good deal can be gathered from the manner, hesitating or otherwise, in which the name is given. If on being asked, a native does not give the name quickly and spontaneously, it is generally useless to continue questioning, or a name will almost certainly be invented.

Again, it must always be borne in mind that even natives who know their trees well are not infallible, any more than we are ourselves, and care should be taken, where possible, to select an example of the plant exhibiting those characters which are most likely to be recognized by the native questioned. A plant, for instance, is often most easily recognized by that part of it which is of the greatest economic use, and which it is to the native's advantage to be able to recognize quickly.

Again, many plants which have a general resemblance to one another in respect of their foliage, are totally unlike as regards their flowers and fruit. In the Jubbulpore Division I have several times recorded *choti* as a vernacular name for *Kydia calycina*, when in leaf, but I have never heard this name given to this species when it is in flower or fruit. On the other hand, it is the common name in this locality for *Eriolaena Hookeriana* when in flower or fruit. These two species, when in leaf, are undoubtedly often confused by natives. The same thing is found with other species, especially the *Grewias*. Leaf examples of several species of this genus are often mistaken for one another, but when in fruit they are usually distinguished at once by a native. In the case of two species which resemble each other, it is, when possible, advisable to ask their names when both species are situated close together, so that they can be readily compared.

16. Many of our Indian trees have a very wide distribution, and, naturally, they are known under a variety of native names in different localities. In our own country we have examples of the same thing, and, as an instance, we may take the common plant *Cardamine pratensis*, which, in neighbouring counties in England, is known as Milkmaid, Cuckooflower, Ladies' smock and Bitter cress respectively, and when we consider the enormous area over which a plant may be found in India, we cannot be surprised at the long lists of vernacular names borne by many of our forest plants.

Here again the great utility of "Local Forest Floras," dealing with a tract of limited extent, will be felt, for they will omit all names which are not used in the locality and will be able to include others which are only found in that region, and most of which have, consequently, been omitted from the larger "Floras." Many of the latter names also will belong to the less known languages and dialects which are the mother-tongue of the forest tribes and which contain many of the best and most fixed vernacular names.

17. In recording vernacular names, we must obviously pay great attention to the personal character of the people from whom we make our inquiries, for this is a factor on which the value of the name given by them to a great extent depends. If we wish to obtain the local name for a plant growing in a Devonshire lane, we should not expect an accurate or reliable one from a man born and bred in the streets of London. Similarly, we cannot expect

reliable or useful information regarding our forest plants from the native whe hates the lonely, fever haunted jungle and all it contains, and who yearns for the pleasures of the large bazaar. The people who, whether from choice or from necessity, have from the earliest times made the forests their homes, who have ever depended on the forest and its products for a large proportion, if not indeed the whole, of their daily bread, and who are possessed of the forest lore accumulated by generations of their ancestors, have learnt to know the jungle and its plants as few others can ever hope to do.

It is, however, an unfortunate fact that the higher classes of native Indians appear always to have regarded these aboriginal forest races with contempt; they were believed to be more nearly allied to animals than to the human creation, and nothing that they knew or possessed was considered worth the knowing or the having,—a detailed and extensive knowledge of forests, in short, was nothing accounted of by the educated natives of India—a state of things not absolutely unknown even at the present day in still more civilized countries.

It is, however, impossible to prevent a feeling of intense surprise when one sees a trained native Forest Officer despising these forest tribes and taking no interest in their language, habits, customs and special forest knowledge, although this is undoubtedly in great part due to the prejudice which has been inherited from the earliest times by the native upper classes. This unfortunate prejudice, coupled with the spread of education, is gradually leading to the disappearance of all those characteristics which typified these most interesting races. The upper classes refuse to speak the *jangli* dialect, and the *jangli* native, when brought in contact with them, is driven to pick up the language which is generally spoken and understood, and, as this "education" proceeds, he gradually begins to despise and forsake the ways and wisdom of his forefathers. On page 14 of the little Gondi Grammar published by the Rev. H. D. Williamson, M.A., of the Church Missionary Society, of Mandla, Central Provinces, the following suggestive paragraph occurs, the italics being mine: "The Gond language only possesses numerals of its own up to ten; if it originally had more, no trace of them is anywhere to be found. Above ten *the Hindi equivalents are used.* In the Mandla, Jubbulpore and Balaghat districts, for which alone I can speak, the *Gondi forms for eight and nine have also become obsolete.*" There seems to be no room for doubt that, if things continue as they are now going on, the Gonds as a distinct and well marked race will eventually disappear, and the same thing, no doubt, holds good for similarly situated races in other localities.

This work of compiling "Local Forest Floras," if fruitful in no other way, will have done a great service if it teaches, as it ought to do, the Indian Forest Officer and his subordinates to take a greater interest in and to appreciate more highly these and similar races,

to study their language and their ways, and to learn and place on record all that such people can teach about our forests.

18. Whether or not the Forest Department can or ought to do anything to preserve these forest tribes from extinction is a question altogether beyond the scope of the present article, but a brief reference to the state of things actually existing in some localities may not perhaps be out of place here.

In some Forest Divisions the rules require that a forest guard should be literate, in order that he may be able to read and check the permits under which produce is passed out of the forests. The Gonds, who are often the best material for forests guards in these localities, being illiterate, are debarred from employment except in temporary posts, such as those of fire guards. If a Gond does go to the existing schools, he is taught Hindi and contempt for the Gond and all his ways.

The Forest Department, and through it the Government of India, will gain much if these primitive races can be shown that we value them and their qualifications by enabling them to earn an honourable livelihood, in good official positions in the Forest Department, by virtue of their skill and knowledge as woodmen and foresters.

How often have I seen a local forest guard suffer through comparison with a Gond, whom the former, in his abominable self-conceit, regards as only fit to be his hewer of wood and drawer of water.

On the one hand, the frocked official with the badge of the Forest Department, unable to move in his forests without a guide, ignorant of, and afraid of, the forest and what it contains, and unable to tell one the name or utility of any tree or shrub, for such things form no part of the education of the ordinary Hindu or Mahomedan gentleman, and to talk Gondi he is ashamed!—the man whom the fiery, choking smell of the waterless forests, which cover the rocky hills of the plains of India, as they lie baking in the fierce May sun and swept by the hot weather "dust devils" fills with loathing and malaria.

On the other hand the Gond, and how immeasurably superior has he appeared in respect of his physical strength, his ability to use his axe and clear his path, his powers of observation, his knowledge of the locality, of the local people, flora, fauna and of everything which interests the "Forester."

This, too, notwithstanding the fact that the forest guard has been duly certified by the Tahsildar, or other Government official, as being "of good moral character," by the Civil Surgeon as having "no constitutional disease or infirmity," and by the Educational Department as having satisfactorily passed the "Upper Primary examination in Hindi!"

From what I have heard and seen it appears that a very similar state of things exists in the forests of many localities in India.

19. The next question to be considered is the method of describing the species. The keys, analyses and descriptions of Natural Orders, genera and species will of course be based on those of Sir Joseph Hooker and Sir Dietrich Brandis, and with such help available, little or no original work will be called for, and the descriptions will offer no difficulty.

Before all things, a "Local Forest Flora" must aim at being practical, and it must, as far as possible, help a Forest Officer to recognize his trees without relying entirely on those characters which the systematic botanist depends on for his identification. A Forest Officer wants to be able to recognize his trees at all seasons of the year, when in flower or in fruit, when leafless, bursting into young leaf, in full foliage, or when the autumn-tinted leaves are about to fall, and hence great attention must be paid to those broad botanical characteristics which will help him to do so.

Professor H. Marshall Ward, in his *Notes on Botanical Characters serving to Distinguish the Principal British Forest Trees*, published as an appendix to Vol. II. of Dr. Schlich's *Manual of Forestry*, and which the author explains in a footnote "are for practical use in the forest," and Sir Dietrich Brandis, in the *Forest Flora of N.-W. and Central India*, have shown us, for European and Indian trees respectively, how much can be done in this direction. As illustrating the great utility of such characters, the following few instances may be taken from among the many which might have been selected:—

Bombax malabaricum.—"The trunk is straight, the upper part cylindrical, at the base generally with large buttresses, running up the trunk to some distance, and often 5 to 6 feet deep near the ground."

"The branches are in whorls of 5 to 7, spreading nearly horizontally, and forming a broad conical symmetrical head. The branches and stem of young trees are covered with sharp thick-set prickles."

Bauhinia malabarica.—"The leaves are acid, and are eaten."

Gmelina arborea.—"Bark grey, or greyish brown, smooth, or scurfy, at last exfoliating in broad, irregular, thick, scurfy flakes, leaving exposed the fresh, light-coloured, smooth surface."

Antidesma diandrum.—"The leaves turn brick-red before falling * * are acid, and made into preserve."

Quercus Robur.—"Spreading tree with zigzag, gnarled branches. Bark brown and rough, with irregular longitudinal fissures. Young branches silvery grey and smooth; many are cast off. Buds short, rather large, fat, ovoid, scaly and pale brown; tend to be clustered at ends of twigs. Leaves * * pale olive and apple-green when young, dark and smooth when mature. Young trees tend to retain the dead leaves in winter."

Fagus sylvatica.—"Young branches olive-green long smooth pointed, pale brown, scaly buds. When the buds open in May, these long chaffy scales (stipules) litter the ground."

20. The botanical description will of course be given first and the broad botanical charcteristics will follow in a separate paragraph, in small print. Here, also, will be noted the season *of flowering, of fruiting, of the appearance of the young foliage* and of leaf-shedding. A brief description of the seed, mode of germination, the young seedling, the first leaves and of the wood should also be given, when possible.

21. In a second small print paragraph would be included notes on the distribution and mode of occurrence of the species in the locality, giving the class of forest in which it is found, the dimensions attained by it in respect of height and girth, as well as useful sylvicultural notes in amplification of, or in addition to, the information given in the lists of the Introduction, regarding the occurrence of seed years, methods of sowing or planting, enemies, etc.

22. A final paragraph, also in small print, would be devoted *to the economic* uses of the species, particular attention being paid to the uses which are known and taken advantage of in the locality in question.

23. The "Flora" would suitably close with an Index of Vernacular and Scientific Names, respectively, and it may perhaps be possible to include a few plates, from photographs, of typical *trees, forest crops and associations of forest plants as found growing* together, in a natural state, in the locality.

24. It now only remains to consider the question of the officers by whom these "Local Forest Floras" should be written. Nearly all trained Indian Forest Officers possess the necessary scientific knowledge, enabling them to satisfactorily undertake the preparation of a "Local Flora" on the lines which have been sketched above, and for many of them this would be a great ambition and a labour of love.

In connection with a proposal to prepare local lists of trees, a suggestion was made in the *Indian Forester* some years ago, that these lists should be prepared for each Conservator's circle by the Conservator with the help of another officer, who was to be placed on special duty for the purpose I believe this to be a mistake. In the first place, as has already been noted above, these "Floras" must be produced as cheaply as possible. And if one officer can do the work, as he certainly could, it is waste of money to have it done by two. At the same time, if one officer alone is to be responsible for the work, he will probably be far *keener on it and more likely to produce the best results than if he* is to share the credit and responsibility with another. As a rule, it will not be difficult to select a division the forest vegetation of which is fairly typical of the area which it is decided to include in the "Flora," and the Divisional Officer of which would be most suitably entrusted with the work. A Divisional Officer who has had *some experience of the locality is in close touch with the people and* the forests, while the study of detail required for the preparation

of the "Flora" will help him greatly in his ordinary work and can easily be carried on *pari passu* with his ordinary duties. He would of course be empowered to ask for and receive information and specimens from other Divisional Officers, who would be required to help him as far as possible. His occasional transfer to other Divisions within the area of the "Flora" would probably be necessary in the ordinary course of events, and this would help, rather than impede, the preparation of the "Flora."

To place an officer on special duty for this work is, I believe, unnecessary and has its drawbacks. This would of course increase the cost of production and it would lead to the idea that this work is something outside of, and not concerned with, the daily duties of a practical scientific Forest Officer, and that the men selected for this undertaking are, or are becoming, Botanical Specialists instead of Experts in Forestry.

25. The preparation of "Local Forest Floras" on the lines which have been indicated above will make use of much of the scientific ability which is now latent in the Department, will increase the reputation of the Department as a Scientific Department, will result in the collection of information which will help to elucidate important pending botanical problems, and, finally, will be of the utmost pratical use in enabling one to acquire easily and quickly an intimate knowledge of the plants contained in the forests of any particular locality, which is absolutely essential for scientific forest management.

The Training of Indian Forest Officers.

IN the January number of the *Indian Forester*, Mr. W. R. Fisher states that a second Forest School on the lines of the one at Dehra Dun is required for the training of the Forest staff of Madras, Bombay, Coorg, Mysore and other Native States of Southern India, to say nothing of Burma, for which an elementary Forest School has already been established.

Mr. Fisher further states that as three-quarters of the instruction at the Dehra Dun school is given in the forest, it is impossible to conduct this work satisfactorily with a large number of students, and adds that the forests of Northern India differ materially from the tropical forests of Southern India.

If the necessity for another Forest School dues exist, then, according to Mr. Fisher, either the present instruction at the Dehra Dun Forest School is unsatisfactory, or the school is unable to provide the necessary accommodation for students from Bombay and Southern India.

Mr. Fisher probably does not mean to assert that the instruction at the Dehra Dun school is unsatisfactory, and if he had referred to the Calendar of that school for 1903 he would have perceived that of the 31 students who obtained rangers' certificates in 1903, no less than 11 came from Madras, 5 from Mysore and 2

20. The botanical description will of course be given first and the broad botanical charcteristics will follow in a separate *paragraph, in small print. Here, also, will be noted the season* of flowering, of fruiting, of the appearance of the young foliage and of leaf-shedding. A brief description of the seed, mode of germination, the young seedling, the first leaves and of the wood should also be given, when possible.

21. In a second small print paragraph would be included notes on the distribution and mode of occurrence of the species in the locality, giving the class of forest in which it is found, the dimensions attained by it in respect of height and girth, as well as useful sylvicultural notes in amplification of, or in addition to, the information given in the lists of the Introduction, regarding the occurrence of seed years, methods of sowing or planting, enemies, etc.

22. A final paragraph, also in small print, would be devoted to the economic uses of the species, particular attention being paid to the uses which are known and taken advantage of in the locality in question.

23. The "Flora" would suitably close with an Index of Vernacular and Scientific Names, respectively, and it may perhaps be possible to include a few plates, from photographs, of typical trees, forest crops and associations of forest plants as found growing together, in a natural state, in the locality.

24. It now only remains to consider the question of the officers by whom these "Local Forest Floras" should be written. Nearly all trained Indian Forest Officers possess the necessary scientific knowledge, enabling them to satisfactorily undertake the preparation of a "Local Flora" on the lines which have been sketched above, and for many of them this would be a great ambition and a labour of love.

In connection with a proposal to prepare local lists of trees, a suggestion was made in the *Indian Forester* some years ago, that these lists should be prepared for each Conservator's circle by the Conservator with the help of another officer, who was to be placed on special duty for the purpose I believe this to be a mistake. In the first place, as has already been noted above, these "Floras" must be produced as cheaply as possible. And if one officer can do the work, as he certainly could, it is waste of money to have it done by two. At the same time, if one officer alone is to be responsible for the work, he will probably be far keener on it and more likely to produce the best results than if he is to share the credit and responsibility with another. As a rule, it will not be difficult to select a division the forest vegetation of which is fairly typical of the area which it is decided to include in the "Flora," and the Divisional Officer of which would be most suitably entrusted with the work. A Divisional Officer who has had some experience of the locality is in close touch with the people and the forests, while the study of detail required for the preparation

from Cochin. The same Calendar would also have shown him that of the 60 Upper Class students at present under instruction, 12 came from Madras, 2 from Travancore, 1 each from Coorg, Mysore and Cochin respectively. The Calendar also shows that students from Bombay are now attending the Dehra Dun Forest School, and Mr. Fisher may be interested to learn that the Bombay Government have now abandoned their provincial school entirely and rely on the instruction in Forestry given in Dehra Dun.

The difficulty at present is not to find accommodation at Dehra Dun for students from all parts of India, but rather to find a sufficient number of candidates desirous of entering the school and possessing an education sufficiently advanced to enable them to follow the course of instruction with advantage.

The conditions in Burma are peculiar. The ranger grade is largely recruited from passed private students of the Dehra Dun School, mainly because of the general ignorance of English which at present exists amongst the subordinate ranks of the Burma Forest Department. It is also at present under consideration to change the curriculum of the elementary Forest School in Burma by the issue of rangers' certificates after passing through an English course of instruction.

Lastly, is not Mr. Fisher himself at present occupied in instructing in England youth destined to apply what they may have learned to forests differing vastly more from the forests of Europe than do those of Northern India from those of Peninsular India. Further, may he not at the present moment be endeavouring to illustrate his theoretical teaching with practical examples culled from his extensive knowledge of Northern India, and may not these enter the ears of some unhappy youth destined never to set foot in Northern India, but to languish in Madras. On his remonstrating with Mr. Fisher concerning this apparent anomaly will he not be met with the perfectly legitimate retort, "The general principles of Sylviculture are the same for every country, the practical applications of those principles you must pick up *in situ*." So say we here.

Plains forests and underground waters.

[Translated from the *Revue des Eaux et Forêts,* by H.]

Examination of the results.—

The mean difference of the level of phreatic water is thus

1·10	metres in the first pair		lower in the forest than outside it.
0·63	,, ,, second ,,		
1·62	,, ,, third ,,		
and 1·15	,, ,, fourth ,,		higher in the forest than outside it.

It is in April—May that the underground water is nearest the surface; in January 1901 and August 1901 the level was lowest. At first it seems strange that there should be such a divergence in

the periods if lowest water level, as also in the shape of the curves for May 1900 to May 1901 and May 1901 to May 1902.

The fact is explained by the two following reasons :—

First, the year 1901 was wetter than 1900, and August and September were especially rainy. In the three months July, August and September, 1901, 376·2 millimetres fell at a neighbouring meteorological station (in September alone the fall measuring 163·5 millimetres), while there fell in the same three months of 1900 only 160·8 millimetres (of which 51·3 millimetres were in September). Under the influence of the excessive rain the level of the phreatic waters, which normally continues to fall till November, rose, and did not fall to an equally low figure till the 20th August.

Ordinarily at Nancy, which is 30 kilometres from the forest, September is, after the first five months of the year, the least rainy, but in 1901 it was far more rainy than any of the other months. Although generally rain affects the subterranean water little at this season, there was on this occasion such an excess of rain that the water level in the borings rose from the 20th August to the 21st September, at least in the open ground, where infiltration is quicker, for under forest the level continued to fall.

Secondly. On the other hand, January 1901 was cold and February was snowy and very cold until the thaw of the 24th. So that until this date the water remained frozen in the superficial layers of the soil. Usually, as one sees from the curve of 1902, the level begins to rise from January under the influence of the heavy rain of October, November and December, which are very rainy at Nancy.

The maximum difference of level varies in the several borings, but in every case it is greater in the open ground than under the forest. The forest in this connection plays the part of regulator that we know it to do in the case of temperature.

If we take into consideration the difference of level of the mouths of the borings and reduce them to one plane, the apparent anomaly of the fourth pair disappears. We see from the means given in the table that in all the pairs of borings the water *(plan d'eau)* under the forest is in all seasons lower than under the open ground to the following extents:—

0·30 for the first pair,
0·20 for the second pair,
0·32* for the third pair, and
0·31 for the fourth pair.

It is certain that the variation in level is more marked in reality than these figures show, since we know that in permeable soil the phreatic layer follows the waves of the ground, though in less pronounced undulations.

But let us accept the preceding figures as incontestible minima, the mean of which is thirty centimetres.

We can affirm that at Moudon *the level of underground water is, in all seasons, at least 3 decimetres lower under forest than outside it.*

This lowering of level is very slight and has nothing disquieting in it. It is sufficient to indicate the general rule for the phenomenon, at least in Europe; but, as I have said elsewhere, and as one might foresee, the action of the forest is proportionately less marked as the trees have more water at their disposal.

In the Russian Steppe Forest, where the annual rain or snowfall is only about 30 centimetres, the first level of the underground waters may be completely exhausted by the forest, as in the case of the forest of Chipoff, where *even the second level*, where it was not altogether wanting, is very poor and situated lower.

Near St. Petersburg, where the climate is wetter and colder,* where evaporation and transpiration are less active, while the rainfall is greater, the difference in level of subterranean water outside and inside the forest is not more than from 0·50 to 1·15 metre.

*Note.		St. Petersburg	Moudon.
		c.m.	
Rainfall	...	45 to 50	88 c.m.
Mean annual temperature			3° to 8°C
94°C.			
of January	...	9°C	0°58C
of July	...	17°C	18°38C

In the forest of Moudon, *where in 1900 the rainfall was 713* m.m. and in 1901 891 m.m., the lowering of the water level is even less. The rainfall is nearly three times that of the Russian Steppe Forests, and, *according to Von Höhnel's figures for the* transpiration of a beech forest of 115 years' age, this provision of rain water would be double that required by an old high forest for its growth and transpiration.

One understands that in those conditions the water only falls by a few decimetres. With a higher rainfall the difference would tend to disappear.

The comparison of curves suggests also other reflections.

In 1900, 1901 and 1902 the level falls at about the same rate in May, June, July and August, to remount in April to exactly the same point. But in September 1901, *instead of continuing* its descending movement, as usual, the curve in open ground rises again, because of the extraordinarily heavy rain of September 1901, and does not fall again as low until the 20th August (an unusual date for low-water level in subterranean waters).

Further, as January and February 1902 were very mild, water was able to move in the ground, and the level rose greatly, whereas in 1901 it was frozen during these months, when the level remained very low. From the thaw of February 1901 the water rises suddenly in March in the well in the plantation, which had a large mouth and quickly felt the influence of the surrounding temperature, while the action of the thaw was scarcely felt at the

*Note.—In the table 0·42 is given.—(Translator.)

same date in the narrow borings (5 c.m. in diameter), which were moreover corked.

The slower infiltration and imbibition of the forest soil is also clearly shown by an examination of the curves. The maximum, reached on the 20th April 1901, by the water in open ground was not reached till a month later in the forest. Similarly, after the heavy rain of September the water rose under the open ground, but continued to fall under the wooded ground, where it did not reach its lowest mark till the 20th September or even 20th October. But 1902 was also very rainy, and immediately the water rose very quickly in open ground, much less so under the forest. On the other hand, from May to June the descent was rapid in open ground, but under forest the level remained steady.

All these considerations very clearly show the regulating and compensating rule of the forest.

We can see at once that the curves under wooded ground are less marked than under open ground and show less wide variations.

Finally frost and thaw have a great influence. Thus February 1901 was very snowy and cold, much colder than January, and the water is motionless, being frozen. The thaw came suddenly on the 24th February, the snow and ice melt, the abundant rain of March (67 m.m.) and more still in April (130 m.m.) are added, and the water level rises quickly in all the borings. It reaches its maximum on the 18th April in borings Nos 1 and 2, but only a month later under the forest, where the crowns, the soil covering and the sub-soil, which are drier and more greedy for water, oppose themselves to as rapid a rise in the phreatic water level as occurs under the open ground surface.

CONCLUSIONS.

These results arrived at in France near Nancy, agree entirely with the first observations made in Russia, notably in 1895 and 1897, and with those first made at another place in Russia, at the Forest School of Staraïa-Russa (in the Government of Novgorod,) near and to the south of Lake Thuen. (All the Russian works which have been translated into French are to be found in the *Annales de la Science agronomique Francaise et Etranger.*)

"One is forced to conclude," says M. Tolsky, in his article on this subject, "that the level of underground water is lower in the forest than in the just exploited coupe, in summer as in winter, and that the oscillations are smaller in the forest."

The question, then, seems settled at least as far as Europe is *concerned*,* and it may be affirmed that in plains forests in which

* NOTE We are careful not to generalise from these results and to say that in all the plains of the globe the forests must have the same effect. It may even happen that the reverse effect occurs, and that the evaporation from uncovered soil has a greater effect than does the transpiration of a forest. This would especially happen in tropical regions with a torrid heat, where the soil evaporates enormous quantities of water in proportion as the temperature is higher.

the soil is formed by the superposition of identical layers with a horizontal stratification, and where consequently the underground sheet of water is motionless :—

1. That the water-level is never higher under forest than under an open ground surface;

2 That the phreatic layer has always been found farther from the surface under the forest than under the ground outside the forest, when the ground section is taken into consideration.

3. That the depression of the level is more marked under old forest than under young forest; and

4. That this depression is more marked also in dry climates than at points where it rains heavily.

In these last conditions it may, as at Moudon, not exceed a few decimetres. Whereas it is not the same thing with transpiration, which is a physiological and not a physical phenomenon. Mr. Ribbentrop has observed an example of this near Madras. It would be extremely interesting to make observations in those regions so as to be able to get an idea of the relations of the evaporation from uncovered soils and the transpirations of forests at all points of the globe.

These conclusions merely corroborate the opinion which has long been held, that forest vegetation has a remarkable faculty for drying up and draining marshy plots. This power that forest has of drying up the soil has been shown by the old examples of the *landes* of Gascony, of *la sologne*, of Marais Pontius, * and others. The role of the forests in this connection is well known.

Whenever it is required to remove an excess of the stagnant water, recourse is had, and never in vain, to forest vegetation.

Its power of transpiration is proved again by the modification which takes place, up to 1,500 metres, in the air above a large forest.

"The cooling felt by aeronauts when passing over woods," writes in 1900 M. Renard, *Chef de Bataillon* of Engineers, and Sub-Director of the Central Military Ballooning Establishment, is shown by a marked fall of the balloon. This descent never stops of itself, as happens when some accidental cause has produced it, but continues till a considerable quantity of ballast has been thrown out. As to the height to which this influence is felt, it of course varies with the extent of the woods below, and perhaps also with the altitude and the configuration of the surrounding country. In any case there is this clear fact certified to by many military balloonists, that the influence is felt above the forest of Orleans (a plains forest of 30,000 hectares,) when the balloon has been about 1,000 metres up. It seems proved by the whole series of ascents made up to date that the influence of forests of a similar area is felt up to about 1,500 metres".

*NOTE.—In the Campagna, at the Convent of St. Paul of the Three Springs at 3 kilometres from Rome, the eucalyptus plantations started in 1870 have lowered the underground water level by several decimetres.

These two facts, the drying up of the soil and the increase in the moisture and coolness of the air above forests are intimately connected. The one is the corrollary of the other. It shows that the forest should be considered to be an enormously powerful pump (*pompe aspirante et foulante.*)

Another result of the two facts abovementioned is that it should rain more over a forest than over another area of equal extent but not wooded.

May I add to the examples which I have cited elsewhere a new piece of evidence recently brought forward, and which appears to me to be very strange. I refer to the influence of the forest of Mormal, of about 10,000 hectares, in the Department of the Nord, on the rainfall of the surrounding plain. One reads in a recent article on the rainfull (*pluviosite*) of the north plain of France as follows :—

" A rather important anomaly is met with at the south side. The precipitations rise rapidly from the Escant (Valenciennes, 705m.m.) towards the Sambre (Le Quesnoy, 795m.m. Gommequies, 907m.m), to fall again beyond the river, *the elevation continuing, however, to increase:* Avesnes, at 183 metres, receives 742 m.m.; Fourmies, at 178m., receives 757 m.m., at Hioson alone, with 196 m., we come again upon more than 800m.m. (806.) *The maximum established upon the upper Sambre, then does not depend only on the elevation. Looking more closely we see that it encloses the forest of Mormal completely in the curve of* 850 *m.m.* Hence the impression that the forest is the factor of augmentation sought. This influence has been determined by M. Bouvart with great precision in a table in which five stations (Bavai, Gommequies, Loequinol, Landrecies, Maroilles) so placed as to feel the effect of the forest are compared with Le Quesnoy, the base station (*station temoins*) situated beyond that influence. When 737 m m. fall at the base station, the mean rainfall (*lame pluviole*) of the five above-mentioned stations is (reduced to the level of the base stations) 855 m.m., that is 188 m m. deeper thanks to the forest. In other terms, it would be necessary to reduce by 16 per cent.* the heights of the water which fell on this part of the country in order to be able to compare them with the quantities of rain of the neighbouring stations; we should thus obtain about 730 m.m. of rain, a figure which in fact approaches that of Avesnes (742 m.m.) and Fourmier (754 m.m). Thus is explained the presence, on the upper Sambre, of a maximum bounded on the east side as well as the west side and which precedes to some extent the maximum which we should find further off, on the much wooded heights of the Ardennes. "

* NOTE.—It will be remarked that this is about the percentage found at Nancy, at Luxemberg and in India.

I have already elsewhere shown that this action of the forest on the phreatic waters is not in any way contradictory to the beneficent influence which it incontestably possesses on the underground layer of *moving* waters of hilly countries where flow (*missellement*) takes place, and on the springs which they feed.

In the plains it is the wells and cisterns, not the springs, *which provide the water. What does it matter if the water of* wells is found at a metre lower down under the forest than under the open ground.

* * * * *

Extremely surprised by the (Russian) results, which seemed to contradict the usually accepted doctrine I wrote to M. Ototsky and others asking various questions in order to have information on the cases cited by the authors and relative to the action of forests upon springs. After having studied nearly all the published documents I arrive at the conviction that the apparent contradiction between facts equally well observed may be explained in part by the considering of the fraction of percolation, and that we must make between plains and hilly forests (where springs are found) a distinction which is necessary from this point of view and which removes all difficulty (*fait cesser toute autinomie*)·

* * * * *

Following from the surprise caused by the Russian results the stations of forest research in Germany, Austria and Switzerland elaborated a programme for the observation of the influence of forests on waters.

* * * * *

NOTE.—Why cannot *we* also elaborate *projects for the* observation of scientific facts upon which the whole of our work (with its infinitely far-reaching effects) is based. If ever there was a place where the scientific study of the action of forests is requisite, and where, too, it should be comparatively easy, by reason of its comparative definiteness, it is India.

As there is no special Research Officer, however, might we appeal to Forest Officers in, say, Oudh to make a few observations in the sense of this article of M. Henri's. The wells are no doubt *generally in clearings (and even small clearings, as M.* Henri shews, are sufficient to have effect), but there are some wells, situated right in the forest, and the levels in these could easily be compared, at different seasons, with those of wells just outside forest limits.

Dr. Cooke's Flora of the Bombay Presidency.

I FIND that there is a slight error under the head of *Bruguiera*, (*B. gymnorhiza*) in Dr. Cooke's excellent *Flora of the Bombay Presidency*."

For	Should read
Bruguiera.	*Bruguiera.*
Fruit, turbinate, thickly coriaceous, crowned at the apex by the lobes of the calyx, 1-celled; seed 1 pendulous germinating as in *Rhizophora;* protruding radicle, elongate, clavate.	Fruit at first imbedded in the turbinate thickly coriaceous calyx tube and surmounted at the apex by the calyx lobes, afterwards protruding, elongate, clavate, 1-celled; seed 1 pendulous.
B. Gymnorhiza.	*B. Gymnorhiza.*
Fruit less than 1″ long, obconic, crowned at first by calyx segments which afterwards drop off, scarlet; protruding radicle fusiform, more or less angled, often reaching 1 ft. in length before falling.	Fruit at first immersed in scarlet calyx tube less than 1″ long, obconic, afterwards protruding, green, fusiform, more or less angled, often reaching 1 ft. (usually about 6 inches) before falling, the calyx tube and segments remaining pendulous on the apex of the fruit till a short time before it falls.

Having occasion to look for the *Bruguiera* in the mangrove swamps of the Kistna district last month (November), I found it in all stages of flower (bud, and open) and fruit; and on comparing notes, it seemed to me that what Dr. Cooke had described as the fruit was really the sub-persistent calyx tube, and what he had described as the radicle was really the developing fruit. The reasons for my thinking this were: (1) that the green projecting portion was for some time crowned by the style, and (2) that inside this green organ was what was evidently the seed, and in a fruit that I picked up on the sea-shore, *this interior seed* had germinated by about ½ inch in length beyond the fruit wall.

I therefore sent specimens to the Reporter on Economic Products, Calcutta, of an unopened bud, a flower after the petals had fallen showing undeveloped fruit sunk in the calyx tube and crowned by the style, a fruit further developed and protruding from the calyx tube, but *still crowned* by the style, a fruit still further developed protruding still further from the calyx tube out from which the style had fallen, a fruit from which the calyx tube had fallen, and a fruit cut open to show the seed.

The Reporter on Economic Products most courteously sent me copies of drawings from Goebel's *Pflanzonbiologische Schilderung*, and asked me to observe the wall of the fruit pushed out in front of the radicle, and that therefore my surmise

was correct: pointing out, however, that the fruit might be said to be ripe when still imbedded in the calyx tube.

I should think it is rather hard to say the exact stage at which the fruit is ripe, if, by the germination of the seed *inside* it, the fruit itself developed to some eight to sixteen times the size which it is before the germination of the seed commences.

I trust that Dr. Cooke will not object to my pointing this out.

7th December 1903. A. W. LUSHINGTON.

Parasitism of Sandal Seedlings in Vizagapatam District, Madras.

THE sandalwood (*Santalum album*) is not a native of the Circars, of the Vizagapatam district at any rate. But having found it doing well some years ago in Ajmere, I got up four seers of fresh seed from Mysore, in October last year, and put the seed down in beds under shade. Only some three hundred young seedlings came up, which I potted and am having put out in different places this year. The nursery was made under a clump of *Eugenia jambolana* trees. When lifting up the seedlings from the beds, I noticed that their young root fibres had already attached themselves to the roots of the *E. jambolana*, little cushions indicating the points of attachment. The connections were always made with the small root-fibres of the *Eugenia* and not with the larger roots. The soil of the seed beds being a more or less stiffish clay, I was not successful in attempting to secure specimens showing the root-attachments sufficiently clearly. However, since the observations were carefully made by me, I have no doubt about the root-connections. There is therefore one more species to be added to the list of 'hosts' of the sandalwood tree already given in the *Indian Forester*. In this connection I also noted that such of the seedlings as had not formed root-attachments always appeared sickly, with scanty yellowish leaves; whereas the others were always vigorous and healthly looking plants. Those in the pots are doing well, although they have no opportunity of forming root-connections with other species, and this I attribute to the leaf mould mixed with the soil in the pots.

GEO. W. THOMPSON.

The treatment of Hardwickia binata.

I SEND the following extract from one of my diaries, which may be of interest with reference to Mr. Fernandez's letter on this subject. The date of the inspection of which this extract is a report was 18th February 1903. It will be seen that my observations and conclusions are entirely at variance to those of Mr. Fernandez. The report refers to the Malapanagudi block, situated 10 or 12 miles south-west of Bellary town.

"This block is an interesting one, as it has been under special protection from grazing, cutting and fires for the last

25 years. The result has been that most of the area, which was then, presumably, blank, has been stocked with Yepi (*Hardwickia binata*), which is the principal species of the block. This species now appears on the ground in different aged groups, from old trees down to young seedlings. There are groups representing all ages. From examination of the younger plants it seems to me that it takes at least six or seven years before a seedling really becomes established and begins to grow, till then it dies off every hot weather. Very possibly the necessary time for a seedling to become established is even longer. There are still a few blank areas which remain unstocked, but seedlings are scattered sparsely over these two."

2. As regards the coppicing of *Hardwickia binata* I have had very little experience, nearly all the trees found in the coupes which have been worked being old pollard trees, which it would be useless to attempt to coppice. Until the last two years, as far as I can ascertain, no attempt has ever been made to coppice the tree in this district; but in inspecting a coupe in the Sandur leased forests, which had been felled about two years ago, I found a stump which had been coppiced about 3 inches above the ground but had not been very well trimmed. It had sent out two coppice shoots from well below the ground, both strong and straight, one a little more than an inch in diameter and about 5 ft. high, and the other rather smaller. This will probably be considered very slow growth for coppice, but it should be remembered that the growth of all species is very slow in this dry district.

BELLARY: H. F. ARBUTHNOT,
1st *January* 1904. *Deputy Conservator of Forests.*

The Commercial Value of Mhowra Seeds.

I.

REFERRING to my article on Mhowra seed in the December number, kindly make the following necessary correction:—Page 6, instead of 5,500 cwts. please read 2,000 cwts.

G. M. RYAN.

II.

MR. G. M. RYAN, in writing on the commercial value of Mhowra (*Bassia latifolia*) seed, in the December 1903 number of the *Indian Forester*, states that he noticed large quantities of Mhowra trees in the Panch Mahals district. He does not mention whether the trees were healthy and in a flourishing condition, but one may take that for granted. Since he was on famine duty in this district in 1899, the forest growth has been much damaged by drought, and among other species Mhowra has suffered severely.

In two blocks of the Kalol Range, comprising an area of 14 square miles, 11,000 large dry Mhowra trees were marked last

year for felling. The same state of things exists over the greater part of the division, as quite 50 per cent. of this species have been killed outright in the forest during the famine years.

A point worth noticing with regard to the areas in which Mhowra has died is that not 10 per cent. of the Mhowra trees growing on revenue land are dry, whereas the mortality in forest is from 50 per cent. and upwards. The cause of this I put down to the better and deeper soil in revenue lands, and also the soil, being broken up for cultivation, absorbs more of the rainfall, and therefore the greater quantity of moisture in the sub-soil of revenue lands helped to pull the trees through the long dry periods of 1899.

The varying percentage in the mortality of teak in revenue and forest lands is similar to that of Mhowra.

Mr. Ryan, in his article, mentions that bears are supposed to eat the flowers of Mhowra. Of this I am fairly certain, as though I have never seen a bear actually eating the flowers, I have seen their pugs leading round and round underneath these trees at the time the flowers drop. Such pug marks are especially easy to see under trees where the grass has been burnt to facilitate the collection of the flowers.

Any jungle Bhil in Khandesh will tell you that bears get sleepy and drunk after eating Mhowra flowers, but I have no direct proof as to this.

Curiously enough, one of my postmen was held up by a bear in a deep ravine in the Khandesh Satpuras, in the same way as described by Mr. Ryan, but though it was during the Mhowra season, I cannot remember if the bear was supposed to have been in any way excited by having eaten Mhowra flowers.

CAMP MOWRA, PANCH MAHALS: R. S. PEARSON.
13th December 1903.

The influence of Forests on Rainfall.

CAN you inform me whether there are any statistics available showing the influence of forests on rainfall. It is, I believe, now a more or less recognized fact by the majority of persons that an increase in the density of forest vegetation causes an increase in the rainfall; and it has been ascertained that in certain localities where the forest has been cut away, that the rainfall is considerably less. I wish, however, to obtain, if possible, statistics showing, say:

A.—(1) Area disafforested; (2) rainfall before clearing; (3) rainfall after clearing.

B.—(1) Area re-clothed; (2) rainfall before reboisment; (3) rainfall after reboisment.

Could you therefore inform me whether there are any such statistics available for any localities, and where they could be obtained.

17th December 1903. A. W. LUSHINGTON.

IV.—REVIEWS.

"Bengal Plants." By Major Prain, I. M. S.

BOTANISTS and Bengal Forest Officers will welcome the appearance of *Bengal Plants*, by Major Prain, Director of the Botanical Survey of India. The book deals with all the plants known to the author to occur in the Lieutenant-Governorship of Bengal (as constituted in 1903), with the exception of the Darjeeling District, *i.e.* a total area of 186,213 square miles, or approximately one-eighth of the whole area dealt with in the *Flora of British India.* The number of species enumerated are 2,895 or roughly one-sixth of the phanerogamic flora of the Indian Empire (excluding Baluchistan). The undertaking has therefore been a very large one, and in order to keep the book within a size convenient for a pocket flora, it has been necessary to greatly restrict the specific diagnoses. This has been done in preference to curtailing descriptions of families and genera. The work commences with an interesting introduction, devoted especially to the description of the eleven botanical provinces into which Bengal has been divided by the author, and it explains the reason for the exclusion of the Darjeeling district and quotes those botanists who have been active in the elucidation of the flora in each province. Among these, Forest Officers, especially Kurz, Gamble and Heinig, occupy a prominent position, but it is to be regretted that no use has been made of the lists of the more important trees and shrubs which, commencing with Homes' short list for the Sundarbans in 1873, and Dr. Schlich's for Chittagong in 1875, have been drawn up from time to time as appendices to Forest Annual Reports and working-plans. Had these been consultedthe omission, for instance, from the Chota Nagpur province of *Vitex leucoxylon* and *Caryopteris Wallichiana*, which occur in the Sonthal Parganas, and the complete omission from the list of the Horse chestnut, *Laportea*, *Linociera macrophylla* and others which occur in the Duars would have been avoided.

The book is published in a paper cover in two volumes, so that it can be bound up in one or two volumes as may be desired, and a map is inserted in Vol. I. On this map, by the way, twelve botanical provinces (omitting Sikkim) are shown, but in the body of the work the Sonthal Parganas are included in the province of Chota Nagpur. As a guide to beginners in Botany there is an artificial key to the genera based on the Linnæan system in addition to the synopsis of Natural Orders. The descriptions of the Orders and genera are very complete. The former are usually in the author's own words. A less free use of alternative characters especially in a work intended for others besides practised field botanists would perhaps have been advisable. Under *Rhamnaceæ*, for instance, the leaves are said

to be alternate or opposite, whereas opposite leaves are exceptional, and the exceptions could either have been mentioned or ignored altogether, as they are not known to occur in Bengal. Under each order a key to the genera is given. The arrangement of these keys is very annoying in practice, owing to the scanty use of letters or other signs to indicate the parallel heads and sub-divisions of the classifications adopted, and the same remark applies to the keys to the species under each genus. The generic descriptions follow very closely those of the *Flora of British India*. In some cases these might have been advantageously modified, *e.g.* the splitting up of the fruit of *Spermacoce* into "two *mericarps*, which ultimately dehisce" scarcely fits the case. What actually takes place is that the valves of the capsule partially separate from the septum from above downwards, and the capsule is also partially loculicidally dehiscent. In *S.hispida* one valve separates from the septum sooner than the other. Again, in the genus Polycorpon petals are sometimes absent, and in the genus *Urena* the ripe carpels are sometimes (*U. repanda*) dorsally tardily dehiscent. The discrimination of species rests entirely on the keys under each genus, and is of course subject to the difficulties which necessarily ensue when attempting to separate species by one or two characters only. Either species not included in the Flora might be identified with one that is included, or the character adopted may not be sufficiently distinctive used by itself. If, for instance, a specimen of *Hibiscus cancellatus* be obtained with 10—12 bracteoles *shorter* than the capsule (which actually occurs), it would be ranged under *H. abelmoschus* by anyone relying on the key on p. 263, or again, were the plant only in flower there would be no means of discriminating it either from *H. abelmoschus* or *H. esculentus*.

In a few cases no province or locality is quoted, *e.g. Jussiæa suffruticosa*. There are also a few omissions noted in the index, *e.g. Alternanthera*, *Carex phacota*, *Cephalostachyum*, *Cheilanthes* and *Ficus Roxburghii* are not found there, but on the whole printer's errors are very few and unimportant. The book should be in the hands of all Forest Officers and others interested in Botany in Bengal.

Forestry.

AN ADDRESS BY DR. SCHLICH, C.I.E., F.R.S., *at the Royal Agricultural College, Cirencester.*

IN November last Dr. Schlich, having been recently appointed Honorary Professor of Forestry to the Agricultural College at Cirencester, inaugurated the founding of the new Chair of Forestry and Estate Management by delivering the following address:—

The Council of the Royal Agricultural College has done me the honour of appointing me Honorary Professor of Forestry at the College. It is an honour which I highly appreciate for several reasons. Apart from the acknowledgment of my humble efforts in the cause of extended afforestation and amelioration of existing methods of managing woodlands in this country, I value the appointment especially because it shows that the authorities of the

College fully recognise the importance of forestry. After all, forestry means the employment of land for a specific purpose, and it forms, therefore, part of agriculture in its wider sense. Indeed, it represents an essential part in the management of almost any estate in this country. The Council have, therefore, acted wisely in taking a new departure by appointing a special Professor of Estates Management and Forestry. I had the pleasure this last summer of seeing a good deal of your new professor, Mr. F. McClellan, and I feel sure he will give a good account of himself. (Applause.) There is yet another matter of great importance to which I must refer. The Principal has alluded to the fact that this College is situated close to Lord Bathurst's estate, a great portion of which is under wood. I cannot claim an intimate acquaintance with these woods, but Mr. Elwes was good enough to drive me through them a couple of years ago, and I can assure you that I was most favourably impressed with their condition and the careful management which that condition indicates. Lord Bathurst, I understand, has been kind enough to place his woods at your disposal for educational purposes, and I think the College owes to his lordship a debt of gratitude for his liberality and public spirit. (Applause.) Let us hope that proprietors in other parts of the country will follow Lord Bathurst's admirable example. (Applause.) Thus the College appears to be well equipped to impart that knowledge of forestry which in these days is considered of great importance in the development of the resources of the land, and through it to landowners and land agents, as well as to the labouring classes, because increased afforestation of waste land provides extra work in the shape of managing the woods and in the development of industries. As regards the latter point, let me remind you of the beech woods in the Chiltern Hills, whose existence caused the development of an extensive chair industry, which uses the produce of these forests as its raw material. Tens of thousands of people are employed in that industry, which would never have seen the light of day without those forests. There is every likelihood that similar industries will spring up in other parts of the country if you create the necessary woodlands. On the whole, then, I think the students of this College are to be congratulated on enjoying benefits which are as yet denied to students at other similar institutions. What I have said so far naturally brings me to the question whether extended and improved forestry is of such importance to this country generally as to justify any special measures to be taken towards furthering it. To answer that question is a complicated matter: hence within the short time at my disposal I can only touch on a few of the more important points.

REQUIREMENT OF FOREST PRODUCE IN THIS COUNTRY.

The production of timber in this country may be estimated at perhaps two million tons a year, and that quantity has probably

not varied very much during the last 40 years. On the other hand, these islands imported in 1864 about three and one-third million tons of timber, and in 1899 ten millions, making an average annual increase of about 190,000 tons. Here, then, is an important fact. Of the timber imported in 1899 about 87 per cent. was pine and fir, and only 13 per cent. so-called hard-woods. Of the latter, 3 per cent. were oak, and the other 10 per cent. teak, mahogany, furniture woods, house and door frames. Some of these cannot be grown in this country. The centre of gravity of these importations rests, however, in the coniferous woods, and these, or efficient substitutes for them, can be produced in these islands. As regards prices, it may be said that they fell from 1870 onwards to about 1888, owing to the great development of the means of transport by sea; from 1888 to 1894 they were steady, but then a reaction set in, so that the years 1894 to 1899 showed a gradual rise in prices equal to about 18 per cent. Then came the war in South Africa, which caused a temporary check, but during the last 12 months the effects of it have practically disappeared. In my opinion, we shall never again see the low prices of 10 to 15 years ago, because the more accessible forests in the exporting countries have been heavily worked, if not exhausted, so that the timber for export has, year by year, to be carried over longer distances before it reaches the sea.

SOURCES OF TIMBER SUPPLY.

Before I proceed to deal with forestry in this country, let me say a few words about the sources whence this timber comes. In 1899 we received from Canada under 2 million tons, from other British possessions rather more than a ½ million tons, total for British possessions about 2½ million tons; from foreign countries 7¾ million tons; total 10 million tons. The latter came from the following countries: Russia, about 2¼ million tons; Sweden, about 2¼ million tons; Norway, about ¾ million tons; Germany, rather less than ½ million tons; France, ¾ million tons; United States of America, 1 million tons. But we are not the only importing country in Europe; on the contrary, most of them import timber. For example, Germany's net imports are 4½ million tons a year; France, 1¼ million tons; Belgium, over 1 million tons; Denmark, nearly ½ million tons; Italy, nearly ½ million tons; Spain, nearly ¼ million tons; Holland, ¼ million tons; Switzerland, ⅛ million tons; and Portugal, Bulgaria, Greece and Servia, smaller quantities. The exporting countries in Europe are Russia with 6 million tons; Sweden 4½ million tons, Austria-Hungary 3¼ million tons, Norway 1 million tons, and Roumania 60,000 tons. If you draw the balance of imports and exports for the whole of Europe, you find that there is an annual deficit of about 2¾ million tons a year, which are supplied by Canada, the United States of America, and smaller quantities from other countries.

ARE FUTURE SUPPLIES SAFE?

My reply is, "By no means." To begin with, the timber which we get from Germany is really only a re-export, because that country has a net import of 4½ million tons a year. It has been known for some time past that Norway is working her forests with a deficit (by cutting more than grows annually). Sweden was hitherto considered as solvent in this respect, but a Parliamentary paper just issued gives a different account. Sir W. Barrington writes from Stockholm to the Marquis of Lansdowne, on the 18th March, 1903: "Recent calculations estimate the annual consumption of timber at some 1,060 million cubic feet, which is said to be about 106 million in excess of normal reproduction." Here, then, is another of our most important sources of supply also working with a deficit. As to Austria-Hungary, very little timber comes to this country, because half their export goes to Germany and the bulk of the other half to various other countries, especially France. There remains, apart from a diminishing supply from Sweden and Norway, Russia. That country has enormous areas under forests, but it has still greater areas without it. Its population is rapidly increasing. Differing views are taken of Russia as to her capabilities of maintaining her export of timber. Some experts say that her resources are inexhaustible, others doubt it. My own opinion, having weighed the evidence on both sides, is that Russia is a somewhat doubtful factor. At any rate, there can be no doubt that the demand is increasing year by year, and that other European countries must reduce their exports. Then as to North America: The United States are no longer a real exporting country, because they import already more from Canada than they export. Thus we are reduced to Canada for making good the deficiency in Europe. That country is supposed to have about 266 million acres of timber lands, and she could, no doubt, supply the rest of the world with the necessary coniferous timber, if her forests were managed in a rational manner, instead of killing the goose that lays the golden eggs. There are also the peculiar conditions of the timber trade, and the great destruction wrought by forest fires, to be taken into account. In summing up this part of the subject it may therefore be said, (1) that we required enormous and ever-increasing quantities of timber, (2) that prices in the future are likely to be higher than in the past, (3) that supplies from outside rest on a very unsafe basis, (4) that the increase of the afforested area in this country, especially by utilising the waste lands, is sure to lead to an increased demand for labour.

STEPS TO BE TAKEN IN THIS COUNTRY.

It is clear, then, that we must look about and see what we can do for ourselves in these islands. A detailed examination shows that we have plenty of land available for extended afforestation. There are altogether some 25 million acres, or 30 per cent., of the land in Great Britain and Ireland which is either

lying waste altogether or used for rough grazing, apart from their value as shooting grounds. It is, no doubt, difficult to estimate the actual returns yielded by these lands, but I feel sure that I am within the mark when I say it is less than one shilling an acre all round. Some of the lands may yield up to half-a-crown, but enormous areas yield considerably below a shilling, even down to threepence an acre. We may safely say, then, that there is no lack of land obtainable at reasonable and even low rates. As regards the climate, there is practically nothing better to be desired, as far as the production of timber is concerned, however unpleasant it may be in other respects. We have, generally speaking, mild winters and cool summers. Of rain we have plenty, often too much, while snow and ice are not nearly so frequent as in other northern European countries. Unfortunately of gales and strong winds we have more than a fair share, but with proper management their injurious effect upon forest growth can be considerably reduced. On the whole our climate, at any rate up to the centre of Scotland, though it may not be equal to that of a great portion of France, compares very favourably with that of Germany, and there is absolutely no reason, in this respect, why we should not grow as good timber here as is done in Germany. At any rate our climate is considerably more favourable than that of Norway, Sweden, and North Russia, whence we import some six million tons of timber a year. If home grown timber has hitherto been considered inferior to timber imported from those three countries, it is due not to the climate, but to the manner in which it has been grown. Conifers have been too heavily thinned while young, so that they yielded knotty timber with broad annual rings. Only let us grow our timber in the manner followed in France and Germany, the countries which share the honour of having developed the science and art of forestry, and we shall produce the same quality of Scotch pine (the red deal of the Baltic) and Norway spruce (the white deal of the Baltic) as that now imported into this country. It is the non-observance in this country of good sylviculture which is at fault, and not the climate. As regards hardwoods, and especially oak, it is asserted by leading timber merchants that the quality of British grown timber is actually superior to that imported from the Continent, but that the latter comes to us in better shaped cleaner pieces, which again indicates faulty sylviculture in this country. On the whole there is no doubt in my mind that we can produce just as good timber in this country as that now imported from other European countries, provided we put our shoulders to the wheel, and teach our land agents and foresters correct sylvicultural methods. At the same time we must not expect immediate results in all cases. In only too many instances the land has suffered in yield capacity owing to continued exposure and the subsequent dissipation of all organic matter. In such cases there will be some difficulty in the

beginning, but if once more a suitable forest crop has been established on the areas, the producing powers of the land will increase in the same degree as organic matter accumulates in the soil. The loss of increment in the beginning is a penalty which we shall have to pay for neglect in the past.

FINANCIAL ASPECT OF BRITISH FORESTRY.

The next question you are likely to ask me is, "Will it pay to put land under forest in this country?" In answering that question we meet with great difficulty. Most naturally you would say, "Let us inquire what the results of forestry have been so far." That inquiry would lead to disappointing results, because in the first place it is almost impossible to obtain, in this country, data which would conclusively prove the case either one way or the other; and secondly, we can only estimate what the effect would be if rational sylvicultural methods were applied to the industry accompanied by a more systematic management. As regards the first point, I must point out that those data which are available are almost invariably vitiated by the fact that many items are included under expenses which have little or nothing to do with forestry by itself. For instance, you find heavy payments for fences which ought to be charged against shooting rents or enjoyment of the chase, or even against the cultivation of adjoining land, to keep the cattle out of the woods. In other cases, fancy roads are kept up for the benefit of the proprietor. As regards the second point, I have no hesitation in saying that the returns might in many, if not in most, cases be doubled by *following* the rules of rational sylviculture and by systematic management. Let me give you an illustration of the latter point.

THE EXPERIENCE OF SAXONY.

There is probably no country in the world which has such complete records about the past management of woods as the kingdom of Saxony. That state possesses 428,000 acres of Government forests, which occupy good, bad, and indifferent land, less of the first and more of the last. The forests go up to 3,000 feet above the sea. The systematic management of these forests was commenced rather more than a hundred years ago, and we have authentic records since the year 1817, which show that the yield in wood in 1817 was 61 cubic feet per acre, and in 1893 it was 92 cubic feet, an increase of 51 per cent. At the same time, growing stock in 1844 amounted to 2,173 cubic feet per acre and in 1893 to 2,658 cubic feet, or an increase of 22 per cent. The net return, after paying for all items of expenditure, amounts to: In 1817-26, 4s per acre; 1827-36, 4·2s.; 1837-46, 4·7s.; 1847-53, 6·3s.; 1854-63, 10·0s.; 1864-73, 14·8s.; 1874-83, 17·5s.; 1884-93 18·4s.; in 1900, 22·5s. It has of course to be borne in mind that the average value per cubic foot of wood in 1817 was 2·1 pence and in 1900 it was 4·5 pence, equal to an increase of 114 per cent. But the increase of net receipts was 463 per cent., or four times greater

than the increase in the value of the wood, due to improved management. *Remember, these figures refer to the whole of the* Saxon State forests, and not to any specially picked out case. There are forest districts in Saxony which give double the above-mentioned net revenue.

OBJECTS OF MANAGEMENT.

The management of forests depends on the objects which it *is proposed to realise. It rests with the proprietor, in so far as his* choice is not limited by the laws of the country, to determine in each case what these objects shall be, and it then becomes the duty of the forester to see that they are realised to the fullest extent, and in the most economic manner. Here you have the fundamental principle in a nutshell. In these islands nearly the whole of the woodlands belong to private proprietors. They desire, in the majority of cases, to have the woods so arranged that they either lend themselves to landscape beauty, or to the rearing of game, or to the production of a particular kind of produce required in the management of estates. Either one or more, or sometimes all these objects, have to be kept in view. Where this is the case, the economic working is sometimes altogether out of the question, *or at any rate, considerably interfered with. And yet, even in* such cases the objects of the proprietor may be realised, and the woods can be made to yield, if not a full, at any rate a fair return, while the proprietor must put down any deficiency in the return against his pleasure, or against shooting rents, or the benefits derived by the rest of the estate.

ECONOMIC FORESTRY.

Where, however, the manager is not hampered in this way, and where economic forestry is aimed at, as it would generally be in the case of extended afforestation of waste lands, the question of finance would stand in the foreground. The forester must decide what to plant, how to plant, and how to treat his woods, so as to realise the highest possible net returns. The answers *to all these questions involve practically a treatise on sylviculture* and forest management, which your professor will no doubt propound to you. On this occasion I can only offer a few general remarks. The financial results may be said to depend chiefly on (1) the soil you have to deal with, (2) the average annual production of the several species, (3) the value per cubic foot of timber, (4) the cost of planting and subsequent treatment, (5) the degree to which the trees are exposed to injury, and last but not least the rate of interest on the money invested in forestry.

RATE OF INTEREST.

It has been said in public by an eminent botanist "that no British landowner will invest money in forestry, unless he is assured of 4 per cent. *on his money." But, I say, is this reason-able?* What other investment of equal security gives 4 per cent.

in these days? Does agriculture proper give 4 per cent.? Why should forestry be expected to give a higher per cent. than agriculture? Let us consider the case of consols for a moment: they give nominally $2\frac{1}{2}$ per cent., but look at the ups and downs which they undergo. A few years ago they stood at 112, now they are quoted at 88, a fall which represents ten years' interest. Such fluctuations do not occur in forestry. Once that industry has been established on a safe basis, it yields a steady income, and the capital is safe from anything like the fluctuations to which consols are subject In my opinion forestry, conducted on proper lines, offers an investment at least as safe as consols, and it seems to me unreasonable to expect more than $2\frac{1}{2}$ per cent. from it. There are millions of acres in these islands fit for planting which are valued at such a low rate that they can be made, if put under forest, to yield steadily $2\frac{1}{2}$ per cent. and more. At the same time, I must lay stress on the fact that all forest operations must be conducted in a truly economic manner. Extravagance has no place in forestry or in agriculture either.

SOIL.

In coming to the question of soil, I desire to impress upon you this fundamental rule: "Never attempt to plant a species which is not thoroughly suited to the locality, that is to say, soil and climate." Every disregard of this rule is likely to lead to financial loss. It is quite astonishing how often this rule is sinned against. Sometimes the planter has not a sufficient understanding of what is the species most likely to thrive best in a given case. This shortcoming must be met by proper instruction, such as you will, henceforth, no doubt receive at this College. In other cases the planter has developed a fancy for a certain species and he proceeds to plant it under all circumstances. This is a most disastrous failing, which the forester must combat with all his might. The subject must be approached with an open mind, and all personal fancies must be absolutely put on one side. No doubt the selection of the right species is a very difficult task, and the subject must be studied in detail. As a general proposition it may be said that "heavy soils are better adapted for broadleaved species, and lighter soils for conifers." This rule is, however, not without exception. Spruce, for instance, does very well on heavy soil. There is a medium class of soil which I shall call loam, which practically suits any of our forest trees; in the same degree as you proceed to heavier soils, the conifers retire, and *vice versâ*. Again, some species, to do really well, require a fertile soil, like sycamore, ash, oak, and elm; others are somewhat less exacting, like chestnut, beech, and silver fir; next come Norway maple, lime, alder, larch, and spruce; less exacting again willows, poplars, birch, Weymouth pine, Scotch and Austrian pine. There are, of course, many other points to be considered, and the forester must make his choice accordingly.

AVERAGE ANNUAL PRODUCTION.

We have as yet in this country very few data which throw light on the possible average production of the various species. The matter is complicated by the fact that certain species grow fast from the very start, while others grow slow at first but make up for it by growing faster later on. Both in Germany and in France the collection of statistics on the question under consideration has, during the last 20 or 30 years, been most actively prosecuted, so that a great mass of information is now available, although it is not yet complete. We have now tables giving detailed information of the progress of woods of beech, Scotch pine, spruce and silver fir; provisional tables for oak, larch, and some other trees. The best available data show that on a locality of average yield capacity in the use of each species, and under proper sylvicultural treatment, larch and ash give the greatest average production under a rotation of about 70 years. Scotch pine under a rotation of about 80 years; spruce 90 years; beech and silver fir 120 years; and oak, 130 years. On fertile soil the culmination occurs earlier and on inferior soils later. If worked under that rotation we can count on an average production in the way of timber as follows; ash, about 40 cubic feet per annum; oak, 46 cubic feet; beech, 57; Scotch pine, 70; larch, 73; spruce, 84; and silver fir, about 111 cubic feet per annum. Placing the value per cubic foot for oak and ash all round at 1*s*. 5*d*; beech 11*d*., larch 11*d*., Scotch pine and silver fir 8*d*., and spruce 7*d*., larch gives the highest annual money production and spruce the lowest. But it must be remembered that the mean annual production culminates at different periods, that of oak being as much as 130 years, whilst that of spruce is 90 years.

THE COST OF PLANTING.

Economy in planting is of great importance because compound interest on the original outlay must be allowed for a long period of time. Generally speaking the cost of planting is greater in the case of broad-leaved trees, such as oak, ash, and sycamore, and smallest in the case of conifers, such as larch, Scotch pine, and spruce. The exotic Douglas fir makes an exception, because its seed is as yet expensive. For argument's sake we may place the cost of planting an acre with spruce at £3 10*s*.; Scotch pine, £4; larch, £4 10*s*.; beech and silver fir, £5; oak and ash, £6. Charging compound interest at the rate of 2½ per cent., we find that the cost of planting amounts at the time of cutting over the wood, in the case of larch (at 70 years) to £25: Scotch pine (80 years, £29; spruce (90 years), £32; ash (70 years), £34; silver fir (120 years,) £97; beech (120 years), £97; oak (130 years), £149.

VALUE OF SOIL FOR FORESTRY.

I cannot take you through all the intricacies of the calculations, but I may say, that based upon the above considerations, and additional data, which I cannot now place before you, I have

calculated the amount which a proprietor may pay for land if he wishes to plant certain trees and get $2\frac{1}{2}$ per cent. on the invested capital. I have, then, to keep on the safe side, deducted 25 per cent. from the amount thus obtained, and I find that he may pay for his land the following sums per acre: for planting oak, £9 11*s.*; beech, £9 17*s.*; Scotch pine, £14 5*s.*; spruce, £15 1s.; silver fir, £16 6s.; ash, £24; larch, £34 2*s.* That is to say, if he obtains the land at a lower rate, he gets more than $2\frac{1}{2}$ per cent. on his investment; if he pays more, he gets less than $2\frac{1}{2}$ per cent. You will observe that larch pays best by far, ash comes next, while oak stands last.

EXTERNAL DANGERS.

Here the hardwoods have a decided advantage as regards insects, fungi, fire, gales, etc. Spruce and Scotch pine are especially exposed to insect attacks, also to fungus attacks, but the most serious thing of all is the liability of larch to be attacked by the canker produced by *Peziza Willkammii.* Indeed, this fungus has now spread to such an extent in these islands that few places will be found where it does not occur. The appearance of this fungus makes the planting of larch in future highly problematic. Great efforts have been made to get at the bottom of this disease, but the results are, up to date, not satisfactory. The Peziza is a wound parasite: that is to say the tree must have been injured in some way, to break the bark and let some sap flow out, to enable the spores of the fungus to germinate. Different opinions are held as to how the injury has been caused. Causes have been given as damage by frost, the attacks of the aphis *Chermes laricis*, hail, wind, and what not. Dr. Massie, of the Royal Gardens at Kew, has lately published an article on the subject in the "Board of Agriculture's Journal." That article does not contain much which was not known before, but it contains one view which I do not consider correct. Dr. Massie maintains that the disease is chiefly due to the damage done by the aphis, inasmuch as the canker generally commences somewhere around a branch, and the aphis mother settles in the angle of the branch with the main stem. This is very ingenious, and I have no doubt that the attacks of the aphis may cause the damage. But, on the other hand, the canker appears where there is not an aphis within miles around. I have just condemned and cleared away a larch wood 17 years old because it was ruined by canker, and I have never seen an aphis within five miles of the wood, although I have watched it for the last eleven years. My personal opinion is that we have not yet got to the bottom of the matter, but that probably snow, ice, and wind have more to do with it than the aphis. If heavy snow or rime settles on the tender branches they are pressed down and probably small rents are caused where the branch joins the main stem. Sap flows out, and gives the spores the means of germinating. It is not improbable that strong wind causes the damage. Unfortunately the

result is that the pure larch woods must be given up The only way to proceed is to plant a sprinkling of larch into other woods. In that case it has a better chance of escaping the disease, and if not it can be cut out in the thinning without ruining the rest of the wood.

INDIGENOUS TREES *versus* EXOTICS.

To sum up, in my opinion the best plan in economic forestry in this country is: Plant ash, sycamore, and oak on lands which are thoroughly suited to it, and conifers, such as Scotch pine, spruce, Corsican pine, and perhaps others on the rest, in either case with a sprinkling of larch. On wet lands, probably, poplar pays best. There can be no doubt that it is desirable to make experiments with such exotics as are likely to suit our climate and soil, but we must be careful not to be carried away by enthusiastic recommendations. It stands to reason that the indigenous species have stood the test of climate, soil, and other conditions, and we know what we may expect of them. Planting exotics, except on an experimental scale, is always a risky matter, until actual experience has shown decided results. And that takes, unfortunately, a long time. There is no knowing what diseases exotic trees may develop, and I think the case of the larch is a case in point. Still the larch has done us good service, at any rate for a time, and there are other exotic species which may do the same. Amongst the latter the three most promising are the Douglas fir, the Weymouth pine, and the Corsican pine. The last-mentioned produces a straighter stem than *Pinus sylvestris*, and suffers less from rabbits. The Weymouth pine gives heavy crops of timber; it is the species which yields the Canadian white pine. Above all, however, the Douglas fir deserves attention. There are two varieties of it, the Atlantic or Vancouver variety, and the Colorado variety. The former is a marvellously fast grower, but it is not quite so hardy as the other. The Vancouver variety is to be recommended for the South and West of England and Ireland; the Colorado, or slower growing variety, for the North of England and for Scotland. The Douglas fir gives a yield that beats the larch in its palmiest days, and I may mention a wood of it on the estate of Lord Ducie which made a most favourable impression upon me. There are, no doubt, other exotic trees which deserve attention, but as I have said already, we should be careful to avoid planting them on any considerable scale until actual experience has shown that they are superior to our indigenous trees, for, as the old proverb puts it, "A bird in the hand is worth two in the bush."

IN CONCLUSION

Dr. Schlich said forestry was an industry based upon science. It could not be studied in the class room only, but there must be instruction and observation in the forest. The treatment of woods differed with every change of conditions, and it was necessary to observe the development of their woods from the time the seed

was laid down till the wood was finally cut over. Above all, continued action and treatment were essential. The want of these had been one of the principal causes why the industry of forestry had not been more developed in this country. However, there seemed to be a little forward movement going on now. Lord Onslow's predecessor appointed a committee some 18 months ago which had led to the provision in the first instance of instruction for those interested in the forestry industry, such as proprietors, land agents, and woodmen. That would be developed at that College, and he hoped similar measures would be taken by other agricultural colleges in the country, and also by our leading universities. Steps had also been taken by the Commissioners of Woods for the instruction of woodmen and forest men on a small scale in the Forest of Dean, where the men received instruction on two days and worked the other four. He wished the students before him all success in the prosecution of their studies in that new branch of work, and he thanked them for the way they had listened to his humble endeavour.

The Advance of British Forestry.

THE question of British reafforestation is centuries old, and from time to time, when the necessary interest to keep it alive has been on the wane, enthusiastic individuals have come forward, and by their fervent efforts have resuscitated it to something like its proper importance in the commercial affairs of the country; but, unfortunately, as soon as their influence has passed away, the fires have been extinguished, and the whole question has lapsed once more into a condition of almost complete public and national unconcern. But the movement which commenced some two or three years ago has apparently taken deeper root, and interest in British forestry is increasing every day. Three forestry societies, which are continually enrolling fresh members, are already in existence, and another is proposed. It was only last week that the establishment of a school of forestry was determined upon for Wales. Our agricultural colleges have for some time had their forestry departments, and the Government have formally recognised the importance of the movement by holding the recent forestry inquiry under the auspices of the Board of Agriculture. To crown the work, and to put into practical shape the many suggestions and proposals which have been gradually crystallising, it is now decided by the Royal Agricultural Society of England to hold a British Forestry Exhibition next year in connection with the annual agricultural show. The following letter appeared on the 28th of November last in the columns of the *Field*:—

Sir,—Upon the recommendation of their Education Committee the Council of the Royal Agricultural Society of England have decided to hold a British Forestry Exhibition in connection

with the society's annual Agricultural Show of 1904, to take place at Park Royal, Willesden, London, N.W., from June 21st to 25th next. A special Forestry Committee, consisting of members of the Council and other forestry experts, has been appointed to organise the exhibition. As chairman of the committee, I am desired by my colleagues to invite the principal institutions engaged in the promotion of scientific forestry, owners of forest and woodland areas in Great Britain, and others, to lend their active co-operation in the endeavour to make the exhibition complete and thoroughly representative of British forestry. The space at the disposal of the society being limited, the committee will endeavour to make such a selection, without duplication, as will be representative of the whole subject of forestry. With this object they propose that the exhibits shall be classified in several section as follows:—

I.—Seeds and cones of forest trees Sowing appliances.

II.—Seedling trees and transplants, showing the effects of nursery treatment as to cultivation, manuring, root pruning, &c.

III.—Woods and plantations, chiefly photographs and diagrams, showing systems of treatment as to mixing, thinning, &c. Photographs of historic or specimen trees.

IV.—Timbers, hand specimens of homegrown woods of various species; also specimens showing the effects of pruning, injuries, &c.

V.—Insects and diseases. Specimens of forest insects and of fungi and their ravages. Characteristic examples of the attacks of game birds, squirrels, voles, &c.

VI.—Plan maps, models, &c., illustrating working-plans, forest exploitation, manipulation of timber, &c.

VII.—Forest and nursery tools, instruments, and appliances.

The committee would be glad if attention were given to comparative exhibits, *e.g.* specimens of young trees showing the bad as well as the good effects of nursery treatment, specimens of timber and photographs showing the effects of proper and improper pruning, dense and open stocking, &c. It would also be useful to have fresh branches, leaves, &c., of nearly related species that are apt to be confused; *e.g.*, species of pine, spruce, fir, larch, thuya, oak, maple, ash, &c. Specimens of exotic timbers that cannot be produced in this country are not desired; but foreign-grown specimens, to be placed alongside of home-grown material, will be welcomed. Objects and plants of purely horticultural interest are not desired. The society will provide the necessary staging and shelter for the exhibits; but exhibitors will be asked to arrange for the delivery of their exhibits without cost to the society and in good condition for their proper inspection by the public.

The Forestry Committee will meet again on Monday, December 7th next, for the consideration of replies to this letter; and it would be of great advantage if replies were posted

before the end of the present month. Any general suggestions for the organisation of the exhibition with which I may be favoured for the consideration of the committee, will be welcomed. Replies may be addressed either to me or to the secretary of the society.

(Signed) GRANBY, Chairman of Forestry Committee, Royal Agricultural Society of England.

13, Hanover Square, London.

—*Timber Trades Journal.*

Proposed School of Forestry for Wales.

WHETHER the fiscal policy of this country has been remodelled on lines as at present suggested by Mr. Chamberlain, or whether the country maintains its career of "free trade," future generations in Wales will have cause to thank Mr. Edward Robinson, timber merchant, of Boncath, for his endeavours, if they meet with the attention and success they deserve, to foster arboriculture in the land of the leek. Some few months ago Mr. Robinson set on foot an important movement which had for its main object the establishment of a school of forestry for Wales. Through his own Council (the Pembroke County Council) Mr. Robinson sought the co-operation of other Councils in Wales, who were asked to appoint delegates to attend a joint conference for the discussion of this pressing question. The meeting accordingly took place on Friday last week at the Shire Hall, Haverfordwest, at which delegates from Pembroke, Cardigan, Carmarthen and Monmouth were present, the other Councils who had fallen in with the movement, but were absent probably owing to the uncentral venue, being Glamorgan, Brecon, and Merioneth. Mr. Robinson explained that the object was the planting of waste and at present unproductive woodlands in Wales. A school could be established with 100 to 200 acres of land to start with, and the option of acquiring a further 500 or 800 acres, and the total capital outlay at the outset ought not to exceed £5,000 to £8,000, which could be contributed by the councils according to their rateable values. It devolved upon the councils to take the matter up, for the Government had not yet acted on the recommendations of three committees on the subject. He believed the Government would contribute about half the amount required, and he assumed that an annual grant of £100 or less from each of the councils would be sufficient to cover all out-of-pocket expenses and give a good return on capital. There were about a million acres of waste land in the Principality which could grow timber. Of the owners half might require assistance, and the planting would cost not more than £6 an acre. Spread over 30 years that would require a yearly grant of £100,000 from the Government, the money to be repaid in that period by half- yearly instalments, and by the end of that time they should have plantations worth from £30,000,000

to £40,000,000. In the whole country there were 21 million acres of waste land and quite eight millions suitable for planting, which in 50 years would be worth fully £650,000,000 sterling. At present we depended on foreign countries for our timber, whilst at least £8,000,000 per annum might be saved if our waste lands were properly afforested. It was proposed to teach forestry on a very limited scale at Aberystwith College, but what was wanted was a bold and comprehensive scheme. Mr. Robinson's resolution, "That it is desirable to establish a school of forestry for the whole of Wales and Monmouthshire," was carried unanimously.

We are glad to see that another conference is to be held shortly, at Swansea, in the meantime Mr. Robinson's address, of which we have given a summary above, is to be circulated amongst the County Councils of Wales.—*Timber Trades Journal.*

THE NEW YORK STATE COLLEGE OF FORESTRY.—From the *Forestry Quarterly* for November 1903 we learn that the New York State College of Forestry has been closed. The ostensible reason for the closure would appear to have been the vetoing by the Governor of the State aid without which the University was not in a position to continue the College. From our contemporary it would appear that the Governor's veto was obtained, directly or indirectly, by persons who did not approve of the logging operation, adopted on the College tracts, the full details of which are unknown to us. Be this as it may, the sudden and early closing of the College is a backward step in the forestry movement in America, which we hope will not find a counterpart in a similar closure of Cooper's Hill

MIDLAND REAFFORESTING ASSOCIATION.—Sir Oliver Lodge presided over a meeting of the Midland Reafforesting Association, held in Birmingham University. Encouraging reports were received as to the attitude of the public towards the scheme for reafforesting the Black Country. It was resolved to take steps to establish a demonstration plantation to show the practicability of tree-growing on the waste lands of the pit district. A resolution was passed in favour of the promotion of an "arbour day." Mr. L. Hodgson, moving a resolution that local authorities be communicated with regarding the rating of land planted with trees, expressed a hope that Parliament would relieve forest lands of the heavy rating to which they were now subject, and which was greatly restricting the growing of timber in England. He was convinced reafforesting conducted on economical lines could be made commercially successful. The resolution was carried. Sir Oliver Lodge urged the importance of enlisting the co-operation of local communities, and a resolution was passed with a view to organising localities.

VII.—TIMBER AND PRODUCE TRADE.

Churchill and Sim's Wood Circular.

1st January 1904.

East India Teak.—The importation of timber and planks has been:—

	1897.	1898.	1899.
	20,428 Loads	18,083 Loads	12,835 Loads.
And the deliveries	18,410 ,,	18,526 ,,	17,017 ,,

1900.	1901.	1902.	1903.
15,024 Loads	12,860 Loads	8,762 Loads	14,658 Loads.
11,053 ,,	13,807 ,,	12,598 ,,	11,888 ,,

The teak market has continued to be rather out of joint during 1903. The importation to London has exceeded the average of the previous three years, but it has been very miscellaneous. The deliveries have fallen short even of the average of the same three years, and will, of course, in no way compare with the old deliveries in the years before 1900. The long continued cessation of regular dependable supplies from Burma and Siam, which seems little nearer its termination than it did twelve months ago, has upset the whole course of the trade, breaking up its channels and dissipating the force of its steady flow. Buyers who cannot replace their stocks and sellers who cannot quote for buyers' requirements both turn their minds to other matters, and the teak trade suffers accordingly. This ill-wind has, however, blown good to the trade with Java. The teak from that country has been largely and profitably introduced into the London market, and to a less extent to other British markets, during the past year. There is little intrinsic fault to be found with the wood even when compared with the best Burmese and Siamese productions. The Dutch shippers and merchants have made commendable and successful efforts to bring the classification and manufacture up to trade standards, and there seems little doubt that this wood will form a permanent addition to the sources of supply for the future. There will be room for all directly a return to normal conditions once more stimulates the ever-increasing demand for this valuable and satisfactory wood. Market prices during the year, while uniformly at a high level, have been easily influenced in either direction by small local and temporary causes.

Rosewood.—East India.—The imports were again larger, but the consumption is steadily increasing, and the stock remaining on hand is small. Good logs sold well and without difficulty, but inferior wood was not so readily placed. Several parcels of planks came forward and found buyers at fair prices, although logs are much more saleable than planks. Prices were steady, with a gradual upward tendency, and with moderate imports are not likely to recede. Quotations are from £7 to £12 per ton for fair

to good parcels. The landings, &c., of East India Wood have been:—

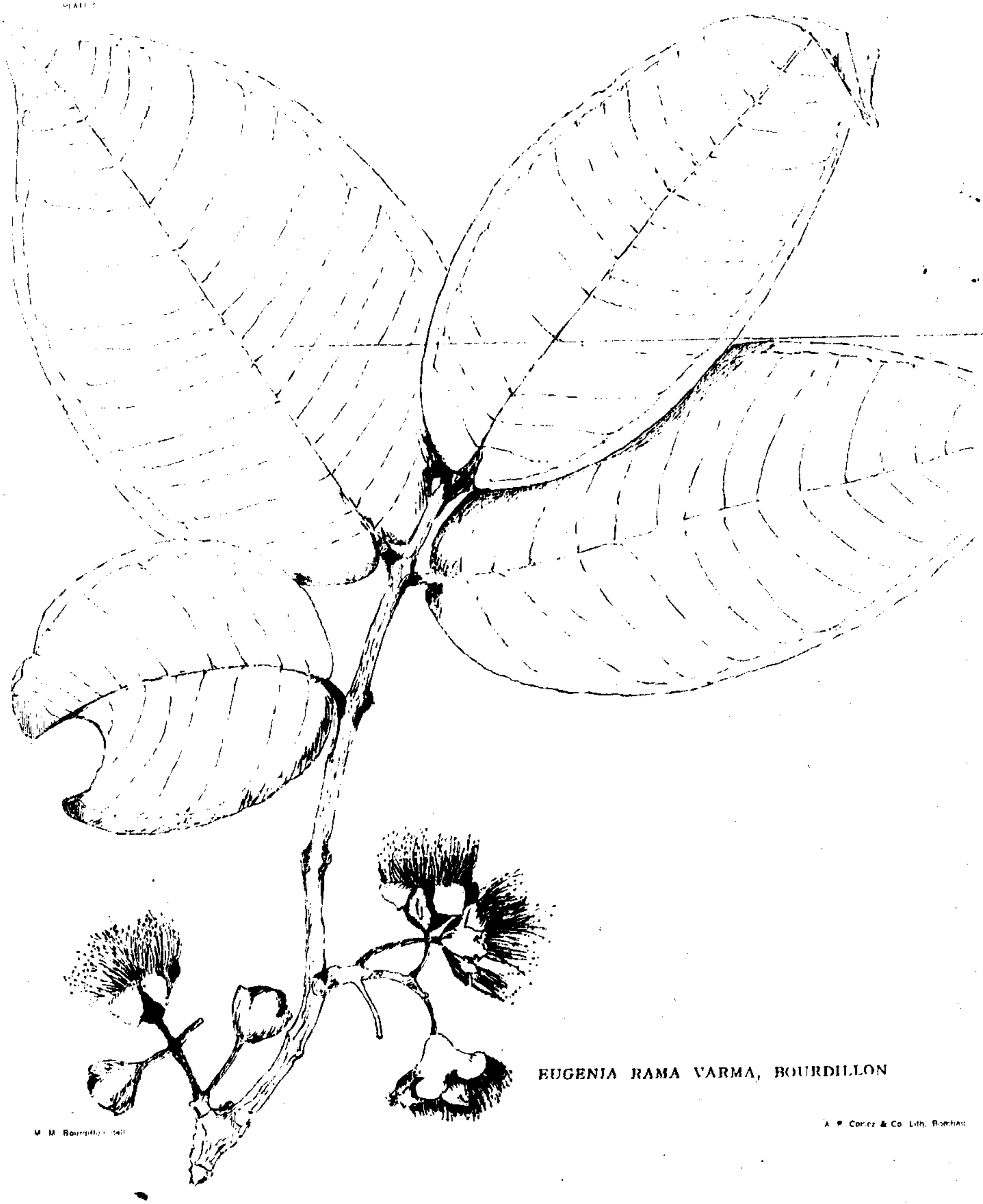
		Landings		Deliveries.		Landed stock, 31st December.
East India	1902	... Not recorded	...	Not recorded	...	53 tons.
	1903	... 536 tons	...	517 tons	...	72 „

SATINWOOD—EAST INDIA.—The import was rather less than that of the previous year. There was a fairly steady demand for plain logs, especially towards the close of the year, when they realised good prices; for really finely-figured logs high rates were obtained. There is a fair stock on hand, but it consists chiefly of so-called figury logs, the value of which is over-estimated by shippers, and consequently the wood remains unsold, as their expectations are unobtainable. Quotations are from 7*d.* to 18*d.* per foot.

EBONY—EAST INDIA.—There was a considerable increase in the imports, some of which were very inferior; the demand fell off, especially in the latter half of the year, and prices weakened; the supply on hand is quite sufficient. Quotations are nominally from £6 to £10 per ton.

PADOUK—EAST INDIA.—The import was again small, and mostly of a poor character. The active demand for good logs was unsupplied, and, being still wanted, they would sell readily, but inferior wood is not easy to clear. AFRICAN.—There was no import to meet the demand for this description, which was good until quite the close of the year, when it fell off in America, buyers there having secured sufficient stock. Quotations for East India wood are from 5*s.* to 6*s.* and for African from 4*s.* to 5*s.* per foot cube.

PLATE



EUGENIA RAMA VARMA, BOURDILLON

M. M. Bourdillon del.

A. P. Cortez & Co. Lith. Bombay

Eugenia Rama Varma - a new Species communicated by J. F. Bourdillon, F. L. S.

MYRTACEÆ.

Eugenia Rama Varma, sp. nov.

Leaves 4—7 in. by 2—4 in., opposite, simple, entire, base cordate gradually narrowing into a long acumen. Secondary nerves 15—20 pairs, connected by a *strong intra-marginal* nerve, all well marked. *Petiole* stout, very short, not exceeding ¼ in. *Flowers* white, 1⅓ in. across, borne singly or in few-flowered racemes on the old wood on ¾ in. pedicels. *Calyx-tube* white, ⅓ in. broad and long, lobes 4, semi-circular, petals 4, white, ½ in. long. Stamens very numerous, white, ¾ in. long on a thickened staminal disk. Style short and stout. Ovary 2-celled with many ovules. *Fruit* greenish-pink, globose, 1⅓ in. diameter, containing one or two large seeds.

A handsome tree of medium size found in the evergreen forests of Travancore and Tinnevelly above 4,000 feet; flowers in March, fruit ripens in June.

This is a rare and local tree, and little is known about it. The timber is hard and strong, but it has not been specially examined. It is named after H. H. the Maharaja of Travancore. [See Brandis' *Indian Trees*, p. 318.]

Effect of Forest on Tree Sap.

BY E. RADCLIFFE, KASHMIR.

FOREST DEPARTMENT.

To a Forest Officer who does not know the reason why, the fact that the moisture absorbed by plants and trees does not freeze during periods of low temperature, when ponds and streams are frozen hard, must be a matter for astonishment. The following information will, to a certain extent, explain the reason :—

Water, as is well known, expands as it solidifies and the mechanical theory of heat points to the fact that if the liquid is subjected to external pressure its freezing point will be lowered.

Sir. W. Thompson, by a pressure of 9·1 atmospheres, succeeded in obtaining water 106° F. colder than ice, and with a pressure of 17·8 atmospheres 232° F. colder.

Moussow, by means of an ingenious apparatus, invented by himself, kept water in the liquid state for many degrees below the normal freezing point.

Water, if allowed to remain perfectly still, may become considerably colder than ice and yet not congeal. If, however, it is subjected to the least motion, or if a fragment of ice be brought into contact with it, it at once crystallizes, and the temperature rises to that of ice.

Despretz, by making use of capillary tubes, was able to obtain water 20° C. colder than ice.

It remains to be seen therefore how Nature applies herself in order to obtain the necessary conditions of pressure on, and absence of motion of, water when absorbed by trees and plants from the soil.

The fact that water rises naturally in capillary tubes will help to explain how seedlings, or even small plants, obtain their moisture from the soil, but this will not be sufficient to explain how moisture is conveyed to the summit of a tall tree It may be surmised that, before a seedling puts forth foliage, the moisture is obtained from the soil by capillary attraction. The action of transpiration by leaves or needles, when they appear, has the effect, more or less, of a syphon, and the flow of moisture through the cells is obtained without interruption. As a

general rule, the larger the crown foliage area of a tree the greater and quicker will be the girth growth of the bole. By the act of transpiration, therefore, a steady flow of moisture is obtained through the cells in the growing portions of a tree.

The question of pressure has now therefore to be explained. Atmospheric pressure accounts for the rise of the moisture in the cells of the young plants in the same way that water rises in capillary tubes. This is the basis; but external heat, by its mechanical process, increases that pressure; hence on a hot day transpiration, which is a form of evaporation, takes place much more rapidly than it would on a cold day. It is only by the cell formation of the tissues of trees that transpiration is possible. The expansion and contraction of the cells in their growth also supplies increased pressure. This question of pressure therefore supplies one of the necessary reasons on which tree life depends during low temperatures. Trees which grow in cold climates have smaller cells as a rule than those growing in hot climates. The smaller cells would act as very fine capillary tubes, inasmuch that water rises in them more easily than in larger cells.

The question of motion is also of very great importance. As long as transpiration continues, the flow of moisture must move upwards rapidly and unceasingly. Nature's provision for preventing this motion during cold seasons is by causing the leaves to fall. (In the case of evergreen trees respiration is checked probably by the temporary closing of the leaf pores.) By the falling of the leaf, transpiration is checked to a very large extent, and consequently the flow of moisture in the cells. Green branchlets and buds supply sufficient transpiration to keep the moisture in continual though very slow motion. The motion is also a steady flow, confined by pressure in one direction, and this, when largely reduced in speed, prevents the water particles from separating and thus causing friction, and consequently heat, which is the outcome of friction. If it was possible to shake water in a vessel in a sufficiently vigorous manner the liquid would boil. The application of heat mechanically separates the particles of water and places them in a violent unsetled condition.

The absence of motion and the presence of pressure are therefore a necessity for the non-freezing of moisture contained in the tissues of trees and plants.

Notes on Measurements of the girth increment of Shorea robusta in Ganjam.

By C. E. C. Fischer, Deputy Conservator of Forests.

SPECIAL interest attaches to sylvicultural notes on *Shorea robusta* in the Ganjam district, as, practically speaking, this is the only forest division of the Madras Presidency in which the species occurs.

As far as I am aware, sal is found in the Presidency, outside Ganjam, only in the Jeypore independent estate and to a very small extent in the agency of the Vizagapatam division.

The former locality is at about the same latitude as the sal tracts of Ganjam, and therefore these latter may be accepted as the southernmost limit reached by sal.

Sal (locally known to the Uriyas as "salwa" or "sodingi") is found in some of the Ganjam agency tracts and in the northernmost taluq of the ordinary tracts—the Gumsur taluq (84° 20′ to 84° 52′ east, and 19° 40′ to 20° 15′ north latitude).

In the agency tracts the Forest Act has not been introduced, and these notes apply to the Gumsur forests only.

Two ¼-acre sample plots were marked out in the Gulleri reserve in 1892 and 1893, respectively, and girth measurements of the sal trees on them have been taken twice or three times a year ever since.

I append a table giving a résumé of the measurements recorded, which explains itself. I will therefore confine myself to a short description of each of the plots.

I.—Suradevi Plot.

1st measurement on 27th July, 1892.

Elevation about 420 feet.

On the lower gentle slopes descending from the Suradevi hill towards the valley now forming the Russellkonda reservoir.

The steep slope of the hill begins 100 yards west. Soil friable loam, very deep and admirably adapted for sal, being sufficiently but not over drained.

Owing to the area having been burnt over every year up to 1901, there is practically no undergrowth.

Last measurement on 14th October 1903.

II.—Mojjagodo Plot.

1st measurement in January 1893.

Elevation about 400 feet.

On a very gentle slope descending towards the west to the Loharakhandi stream. Nearest hill ½ mile north-east, towards which the forest improves a little.

Soil a somewhat sandier and poorer loam than that of Plot I and not so deep.

Nodular limestone probably not very far below surface.

Well drained.

Though not under fire protection prior to 1901, this area seems to have escaped burning more frequently than Plot I. and consequently the undergrowth is in a better condition, though far from satisfactory, containing as it does a large proportion of "weeds" (*Phœnix acaulis*, *Desmodium pulchellum* and *latifolium* etc.) and small climbers (*Phaseolus mungo*, *Atylosia scarabeoides*).

Last measurement on 18th October, 1903.

Plot.	Date of initial measurement.	Period elapsed—years.	No. of trees at initial measurement.	No. of trees now remaining.	AVERAGE ANNUAL GIRTH INCREMENT IN INCHES. Class I, under 18" girth. No. of trees.	Class I, under 18" girth. Inches.	Class II, 18"—36". No. of trees.	Class II, 18"—36". Inches.	Class III, 36"—44". No. of trees.	Class III, 36"—44". Inches.	Class IV, over 54". No. of trees.	Class IV, over 54". Inches.	For whole plot, inches	Largest individual average increment, inches.	Smallest individual average increment, inches.
													Im	In.	
I—Suradevi ...	27-7-92	$11\frac{1}{4}$	51	42	10	525	41	·386	2	·705	...	...	393	·77	·13
II—Mojjagodo ...	January 1893	$10\frac{3}{4}$	57	54	10	·23	44	·28	4	·625	1	·62	·288	70	·01

N. B.—The trees in the various size classes total up to more *than the full* number of trees for the whole plot; this is due to the appearance in two classes of such trees as during the interval have passed from one class to the one above; their averages are of course shown in each case only for the actual period they remained in the particular class.

With regard to the tree which has only put on an average annual increment of ·01", I find the entry, dated October 1899, against it: "Suppressed all round." The girth recorded in 1893 was $14\frac{7}{8}$," and in 1903 $15\frac{1}{8}$," but in October 1899 its girth is shown as $15\frac{1}{2}$". This seeming discrepancy is no doubt due to the drying and pealing off of the outer bark. I find similar *anomalies in many cases, though none* quite so pronounced. I expected to find that these differences would occur at regular seasons of the year, but the figures do not support this presumption, the sudden decrease in girth occurring at various times of the year.

Mycorhiza: Translated from the Revue des Eaux et Forets, by H.

PROFESSOR HENRI has, in the November number of the *Revue des Eaux et Forêts*, written a useful note giving a résumé of the investigations to date on the *Mycorhiza*—literally root-fungus—and the point to which scientists have got in dealing with this question. His article is roughly translated below:—

The very interesting, but as yet imperfectly clear question of the role of the *Mycorhiza* in the nutrition of forest trees has been latterly the subject of a certain number of researches, and we propose to here analyse the most important of these.

The botanist, Frank of Berlin, described in 1885, under the name of *Mycorhiza*, an association between the roots of very many forest trees and mycelian filaments, an association so intimate and regular that the root with its mycelium constitutes a morphological whole as clearly characterised as a normal organ.

The study of the associated parts and of the conditions under which this union occurs led Frank to see in it a fact of symbiosis. The mycelain filaments of the *Mycorhiza*, that one finds so commonly in the Cupuliferæ and the genus Abies, would absorb nitrogen in the form of ammoniac or starch as well as mineral salts to supply them to trees.

The greater number of botanists, after having verified the accuracy of the descriptions given by the German professor, adopted his view with enthusiasm. There were, however, some detractors, of whom the chief was the eminent forest botanist R. Hartig. The latter stated in 1888 that these mycelian filaments were simply parasites, of which so many are found upon the various organs of plants and to which they cause no great harm. The hypothesis of Dr. Frank upset, said Professor Hartig, all hitherto admitted opinions relating to the nutrition of trees, and nothing obliged us to accept for the Cupuliferæ, the Abietinæ and the Vacciniæ, a form of nutrition so special and so entirely different to that of the other ligneous species. He considered that these fungi were only parasites, living on roots without killing the tree, just as innumerable parasites were to be seen upon leaves with practically no influence upon the plant. Though, he said, his opinion was quite commonplace, it was better justified by facts than that of Dr. Frank. However, a little later (1891) Hartig came round to the opinion of Dr. Frank and wrote:—"The complexity known under the name of *Mycorhiza* is a symbiotic association, that is such that root and fungus are associated in a common life and appear as a new being with characteristics of its own." But he adds a little after:—"Frank has expressed the idea that these root fungi have an importance of the first order for the nutrition of trees, by rendering the elements of humus directly utilisable through their means. According to him, not only carbonic but also nitrogenous matter would be directly furnished to the roots by the fungus. Further research would be needful in order to prove this theory, which, so far (1891), was neither sufficiently demonstrated nor refuted. The fact that always, even in humic soils, a great number of the roots is free of fungi and that plants prosper admirably with the *Mycorhiza*, obliges us to adopt a certain reserve in connection with Dr. Frank's theory. His experiments with young beech and Scot's pine, according to which these plants were worse developed in a sterilised soil than in the same soil when not sterilised, does not prove that the death of the *Mycorhiza* would be harmful to the young trees, for, by the sterilisation, the soil had undergone other modifications harmful to vegetation."*

* Thus the sterilised soil had lost the bacteria which, since the work of MM. Duclaux, Laurent, etc., we know to be most useful to the germination and the vegetation of young plants.

Judging from the researches made at the Experimental Station of Tharaudt (Saxony) by Messrs. Nobbe and Hiltner, the reserve of Hartig would be perfectly justified M. Deherain writes (1899):—"They reduce to nothing the hypothesis of Frank (the theory of the *Mhcorhiza*, nurse of trees). For 25 years they have there successfully cultivated in a silicious sand absolutely without organic or nitrogenous matter, silver firs, pines, larch and beech, of which the roots do not show a trace of the *Mycorhiza*."

We ought to say that we have not obtained the same results at the Forest School of Nancy as at Tharaudt. Pines and Spanish chestnuts have been grown for six years in pure sand without nitrogen or organic matter. If, in May, the time when the new *Mycorhizas* form and are in full activity, we very carefully take up a young pine or chestnut, we find that all the roots are mixed up with numerous brown mycelian filaments and the presence of the characteristic coral-like root *Mycorhizas* is shewn.

There is, therefore, as we see, divergence of opinion, not only on the role and the significance of these organs, but even upon their usual presence or otherwise, and it is not the last publication, which it remains for us to consider, which will throw light on the numerous obscure and disputed points of this question.

The recent researches of Dr. A. Müller have dealt with pines of one and two years old, grown either in humus which has been rendered neutral, or in plain (*brut*) humus, or in grey sand, or in yellow mineral sand. In the plain humus the growth has been good, and the almost general presence of endotrophic *Mycorhiza* was noted, while the ectotrophic *Mycorhizas* appeared only in the soils without humus or poorly provided with it. In the neutral humus (or forest vegetable mould) *the Mycorhizas were entirely absent.*

In presence of this fact contrary to what has been up till now admitted, it becomes difficult to deliberately come to a decision in connection with the association of roots and mycelian filaments. For the rest the following is the opinion expressed by the author at the conclusion of his long and minute researches, an opinion with which we personally conform, and which we will cite textually:—"Far from holding as settled the question of the *Mycorhiza*, I believe that the very remarkable relation, between the fungi and the roots of the higher plants will be, and ought to be, the subject of important and attractive studies. In this matter it is especially necessary to abstain from generalising and from forcing the few little facts which are known to be true into a preconceived mould. It is certain that these researches often provoke, and quite legitimately, the conception of theories and hypotheses which ought to be confirmed or refuted. But for the moment we have, in my opinion, gone far in this direction; we

have even theorised to such an extent that nearly all imaginable hypotheses have found defenders. We can only attain to useful work after isolated and careful researches. If I regard the fact noted hitherto for our forest trees, I can only adhere with the fullest conviction to what Dr. Sarauw has lately written to me, *viz.*, 'To my mind it has not been shown, either by observations made in nature, or by experiments, that the fungus of the *Mycorhiza* is advantageous to the roots of forest trees and to the trees themselves.'"

In his turn M. Müller, Director of Forests in Denmark, affirms, in his recent work, that the roots of the mountain pine are densely covered with dichotomous *Mycorhizas* in the soil of the *dunes* of the shore of Jutland, which is absolutely without humus, but that, in contradiction of M. Müller's results, they are present also in the soils of the "*landes*" of Jutland, which contain an acid humus. In such soils it has been found that the spruce does not thrive in the areas artificially planted, unless mixed with mountain pine. This it was which led to the *Mycorhizas* of these two species being made a special study. M. Müller found on the roots of the mountain pine ectotrophic *Mycorizas* of two sorts, first those which he calls rootlike (*racemenses*,) which imitate the normal structure of the laterally ramified root, and which are the commonest in the case of the Cupuliferæ and Coniferæ, and secondly, others, called dichotomous, which issue from the young terminal root and present at first the form of a small tubercle, which soon becomes dichotomons.

The resemblances which exist between the dichotomous tubercles of the mountain pine and the dichotomous tubercles of the Elders and of the Eleagnaceæ or the simple tubercles of Podocarpus, suggested to the eminent Danish forester the idea that the tubercles of the pine might render to the tree which bears them the same service which is rendered to their trees by the two other groups of tuberculous formations. We know that it has been shown by the work of Messrs. Noble and Hiltner that these latter play an important part in assimilation of the free nitrogen of the atmosphere.

Fire Protection in the Teak Forests of Lower Burma.

I.

I SEND as a rejoinder to Mr. Walker's article under the above heading the following extract from the diary of Mr. A. E Ross, Deputy Conservator of Forests, Thaungyin Working-plans, dated 15th December 1903. It affords a recent instance of damage done by fire to teak trees growing in rich teak forests. It is noteworthy that the loss observed has occurred in one hot season. Mr. Ross expresses the belief that the forest in question had been annually burnt, but the damage was observed in a sample area which had been examined last year. Mr. Ross writes:—

"The results of fire in the rich teak forest in the bend of the river, immediately above where the Melama road crosses the Thaungyin, and just below this point, are appalling. Last season the counting in a sample area of about 180 acres, gave 24 dead teak trees over 3 feet girth and 26 sound teak trees over 7 feet. This season the counting gave 15 dead trees and 17 green ones of the same girths. Some of those missing are lying on the ground due to fire. As far as could be ascertained none have been removed by any contractor since last season. Up to now in this part of the reserve the forest outside the fire-line, including all the richest portions in the bends of the Thaungyin river, has, I believe, been annually burnt outwards from the fire-line by the fire coolies. If my advice were taken the bends of the river *containing rich teak forest would be specially protected.*"

I may explain that the adoption of the plan which Mr. Ross advises was ordered several months ago. He was himself in charge of the Thaungyin division in the previous season. The cutting off of the bends of the Thaungyin river, in order to shorten the fire trace, has to be done within the reserve, because the other bank of the river is Siamese territory.

Perhaps other officers who know their forests well and can cite similar instances of the damage done by jungle fires in teak forest, will kindly describe what they have seen It is not necessary to write a very long article. An ounce of fact is worth a ton of theory.

TOUNGOO. *F. B. MANSON.*

II.

A paper by Mr. H. C. Walker in the December *Forester* on fire protection in Lower Burma, seems to call for some remarks, for while it is not possible to follow much that he says, there are points in it which are worthy of consideration.

Mr. Walker's arguments are somewhat discursive, and it is not always easy to understand what the writer means. but after a careful perusal of it it may be gathered that Mr. Walker is in the position of an agnostic as regards the protection of teak from the effects of fire, and that he thinks more harm may be done to the young teak by encouraging the growth of useless species, which increase the shade and so have a prejudicial effect on it, than could be expected to accrue from any amount of forest fires.

Now it is hard to see how this can be arrived at by exact proof, for sylviculture is a science based on observation, and as Bagneris says at the commencement of his *Manual*, "comme tout ce qui repose sur l'observation, la sylviculture est toujours perfectible." In this spirit we may welcome Mr. Walker's remarks as a step in the direction of true science.

To begin with, it is not possible to take up the question from the same point of view in all places where teak grows. Nothing can be more dissimilar than the conditions of teak vegetation in the forests of Lower Burma and in the Panch Mahals in Bombay. But as Mr. Walker is writing of Lower Burma these observations will be confined to his paper.

Mr. Walker says "It is a general belief that fire is responsible for a great number of hollow trees;" also "old age, suppression, etc , seem to me sufficient to account for the hollow trees we find, and I entirely fail to understand how the burning back of a teak seedling can possibly cause hollowness."

It does not require a long acquaintance with the forests to know that hollow trees are not necessarily by any means always old trees, and that many, nay most full grown teak trees are hollow, sometimes for several feet up the butt. It was in old days in Burma, as well as elsewhere, the usual practice of the natives to build a scaffold round a teak tree and fell it several feet from the ground, because the butt was useless from being hollow. How does he account for this? By suppression? Of what description?

Mr. Walker is no doubt quite right in saying that a teak tree has great powers of resistance against fire. But he seems to overlook the fact that the damage to the growth of the tree is caused by the scorching of the bark, which interferes with the

rising of the sap: and it is to this cause that in the majority of cases the injury is due in the growth of the tree, which Mr. Walker, at the foot of page 559, attributes to suppression by shade. The fire is certain: the shade can only be a supposed cause.

However, all will agree with Mr. Walker when he says that the object of forest conservancy in teak forests should be to increase the production of teak trees, and it certainly would seem useful to institute a series of careful observations, in different localities, to endeavour to ascertain whether in a climate like Lower Burma, where natural vegetation is so luxuriant, protection of the forest from fire may or may not have the effect of encouraging the growth of certain less valuable species to the detriment of the regeneration of teak. With regard to such details as "keeping a few typical areas under observation and noticing the extent to which they suffer from fire: and whether slight wounds develope into large ones, or gradually heal up" etc., Mr. Walker himself might be so good as to carry out experimental observations himself and communicate the result to the *Indian Forester*. Such results, in a practical form, would be interesting to all its readers; indeed a pennyworth of practice is worth many pages of speculative discussion.

AN OLD PROTECTIONIST.

A Portrait Gallery of Forest Officers.

I SHOULD like to make a collection of signed and dated photographs of as many Indian Forest Officers as possible for an album to be kept in the Library of the Forest School at Dehra. Such a collection would in time become quite historic and full of interest.

May I, through the *Indian Forester*, ask Forest Officers if they will be so good as to let me have their photographs for this purpose. I should be very much obliged to them.

Dehra Dun, 4*th February* 1904. A. G. HOBART-HAMPDEN.

Reproduction by Sucker Shoots.

THE term *root-sucker* has become an expression of ordinary parlance, but it is possible that some botanists would laugh at the term, for a root is supposed to differ from a stem and its branches by (*inter alia*) the former never producing leaf-buds. *Root-suckers* are the young shoots that spring up from intervals of what are ordinarily called lateral roots, but more strictly speaking perhaps should be underground branches ; at these intervals the buds send up vertical stemlets and downwards root-lets; perhaps a better expression for these growths would be *sucker shoots*, which would contrast this mode of reproduction with that of coppice shoots.

It is rather surprising how little attention is paid to reproduction by sucker shoots ; it does not appear to have met with as much recognition as it would seem to deserve.

In looking through Gamble's revised *Manual of Timbers* for instance, whereas in so many instances the various species are said to "reproduce well from seed and from coppice," and even "from cuttings and slips," I think there are only ten species, *Ougeinia dalbergioides*, *Dalbergia sissoo*, *Pterocarpus santalinus*, *Acacia dealbata*, *Diospyrus melanoxylon* (including *Tomentosa*), *Millingtonia hortensis*, *Stereospermum chelonoides*, *Anicennia officinalis*, *Artocarpus hirsuta*. *Populus euphratica*, which are definitely stated to reproduce from sucker-shoots, and two others

Heritiera minor, *Rhizophora mucronata*, in which this mode of reproduction is distinctly hinted at but not definitely stated.

Again, Sir D. Brandis, in his *Forest Flora*, mentions only the following nine species:—*Ailanthus glandulosa*, *Balanites roxburghii*, *Zizyphus nummularia*, *Prosopis spicigera*, *Cornus sanguinea*, *Diospyrus melanoxylon* (including *Tomentosa* and *Tupru*), *Hippophæ salicifolia*, *Alnus incana*, and *Populus tremula*.

In my peregrinations of the last few years, my attention has been drawn to the fact that a very large number of woody plants produce sucker-shoots, and the following may be mentioned: *Polyalthia cerasoides*, *Anona squamosa*, *Kydia calycina*, *Helicteres isora*, *Eriotaena quinquelocularis*, *Grewia orbiculata*, *Ægle marmelos*, *Balanites Roxburghii*, *Boswellia serrata*, *Balsamodendron (Protium) candatum*, *Melia indica*, *Soymida febrifuga*, *Chloroxylon swietenia*, *Celastrus emarginata*, *Etæodendron Roxburghii*, *Schleichera trijuga*, *Dodonæa viscosa*, *Buchanania latifolia*, *Odina wodier*, *Ougeinia dalbergioides*, *Dalbergia latifolia*, *Dalbergia sissoo*, *Dalbergia paniculata*, *Pongamia glabra*, *Pterocarpus marsupium*, *Cassia fistula*, *Cassia auriculata*, *Cassia montana*, *Cassia Siamea*, *Tamarindus indica*, *Xylia dolabriformis*, *Acacia eburnea*, *Acacia leucophlæa*, *Acacia arabica*, *Acacia catechu*, *Albizzia procera*, *Albizzia amara*, *Albizzia odoratissima*, *Pithecolobium dulce*, *Terminalia tomentosa*, *Anogeissus latifolia*, *Alangium Lamarckii*, *Randia dumetorum*, *Ixora parviflora*, *Morinda tinctoria*, *Lumnitzera racemosa*, *Aëgiceras majus*, *Diospyros melanoxylon* (including *Tomentosa*), *Diospyros chloroxylon*, *Schrebera swietenioides*, *Wrightia tinctoria*, *Millingtonia hortensis*, *Dolichandrone falcata* and *crispa*, *Tecoma stans*, *Heterophragma adenophyllum*, *Lantana camora*, *Tectona grandis*, *Vitex negundo*, *Vitex altissima*, *Avicennia officinalis*, *Santalum album*, *Bridelia retusa*, *Flueggia leucopyrus*, *Mallotus philippinensis*, *Antidesma ghæsembilla*, *Excæcaria Agallocha*.

It may perhaps be interesting to locate where some of these were found producing sucker-shoots.

In the *Indian Forester* some years ago there was an article about the black wood (*Dalbergia latifolia*) and its reproduction from sucker-shoots; but in the fellings recently conducted in the Nallamalais of Kurnool there are prolific sucker-shoots both of this species and of *Dalbergia paniculata* whilst in the Chirala plantation of Bopatla taluq, in the Kistna district, there are several sucker-shoots between each pair of plants of *Dalbergia sissoo* planted six years ago. When I was in Cochin nearly four years ago the Conservator, Mr. Alwar Chetty, pointed out to me how very prolifically the iron wood (*Xylia dolabriformis*) was springing up from sucker-shoots, especially in areas which had been burnt over by fires and where the roots where at all exposed.

In Coimbatore district on the Dimbham (16-17 mile) and Bellaji ghauts, *Ougeinia dalbergioides* shows fine example of the same method of reproduction, whilst sandal in that district has latterly been propagated chiefly by that means, the example having been set by Mr. P. M. Lushington, who first instituted the method of exposing the upper surface of those roots that were too small to be dug up for sale. The same takes place also at Sandur forests in Bellary.

When pulling up what appeared to be seedlings of babul (*Acacia arabica*) in the Kistna district, they were found not to be seedlings at all, but sucker-shoots; and this operation was done similarly for the white babul *Acacia leucophlœa*, *Cassia fistula*, and *Cassia auriculata*. The babuls (including *Acacia eburnea*), *Prosopis spicigera*, and *Melia indica*, were found to be similarly reproducing themselves in the Khojjapalli Reserve in Anantapur district, and in many other places in that and the Kurnool district.

By far the greater part of these species were noticed in this way, however, on the road from Kallipatti to Ramandrug in the Bellary district, where the cutting on the side of the road offers excellent facilities for seeing the root system. In that locality it was found that *Hardwickia binata*, satinwood (*Chloroxylon swietenia*), ebony (*Diospyros melanoxylon*), *Anogeissus latifolia*, Cutch (*Acacia catechu*), *Schleichera trijuga*, and lantana, all produced a most abundant crop of sucker-shoots, whilst teak (*Tectona grandis*) and *Terminalia tomentosa* produced very few, kino (*pteracorpus marsupium*) hardly any, and lesser venteak (*Lagerstramia parviflora*) none at all.

In the mangrove swamps near Nizampatam in Kistna district, *Lumnitzera*, *Anicennia*, *Ægiceras*, and *Excœcaria* were all seen to produce them; but there was also a copious growth from seed, which (as did also to an enormous extent that of *Derris uliginosa*) collected in long series of lines along the level of the high tide.

Finally, Mr. Cowley-Brown, Working Plans Officer, informs me that in pulling up what he believed to be sal seedlings (*Shorea robusta*) he has found them also to belong to the root system of a larger plant of the same species.

In the case of black and white babuls (*Acacia arabica* and *leucophlœa*), of Cutch (*Acacia catechu*, variety *Sundra*), of *Prosopis spicigera* and a few others, the mode in which these sucker-shoots developed was sometimes most remarkable and characteristic: they came out usually in radiating lines around the stump of the tree (especially of trees that had been felled), and very often those nearest the tree were largest, gradually getting smaller and smaller along the line as they were further away from the stump.

There almost always (but not always apparently) seems to be a better chance of suckers springing up when a portion of the

upper surface of the lateral root (or underground branch) is exposed in places; and as mentioned above, they seem to come up more prolifically from trees which have been felled; the former development, I presume, is due to the tendency to form buds under the action of light (or perhaps rather due to the tendency of such buds to lie dormant when not exposed to light); the latter development to the tendency of the sap to go to other parts of the tree when it is impossible for it to rise up the trunk owing to its having been felled.

I have always heard it said that babul (*Acacia arabica*) regenerated itself most prolifically from self-sown seed; that it does so, I do not deny; but I have found that a very fair percentage of what I always supposed to be seedlings (and have found several other officers have made the same mistake) have been these sucker-shoots: and I have wondered since then whether by any chance other gregarious species do not, after a heavy thinning, likewise produce a large percentage of what are ordinarily supposed to be seedlings but really sucker-shoots.

It has seemed to me too that in some of the terribly mutilated forest growths and scrubs that we come across, a very large proportion of the growth is from these sucker-shoots, possibly also hacked down to form an apology for a coppice, but practically reproducing itself to a large extent from sucker-shoots; and in the case of hills where vegetation has been cleared out almost altogether, would it not be advantageous to try and make use of this growth, finding out the root system of trees that still grow, and expose their roots (*i. e.*, underground branches) in the endeavour to make them produce sucker-shoots some distance away from the parent tree?

In the Adoni taluk of the Bellary district the ryots have adopted a method of planting, which is both curious and at the same time most successful. They raise small bunds about 1 to 2 feet high, and dibble in seeds chiefly nim, (*Melia indica*) just before the rains on the tops of these bunds. They pay no further attention to them, neither water nor culture them; and yet the results in most cases have been excellent.

It might be advantageous therefore in some of the almost bare hillsides, such as are so frequent in the Ceded Districts, to combine these two principles, extract the earth from the underground branches of existing trees, so as to produce sucker-shoots, and with that earth raise bunds in which to dibble seeds of plants likely to grow in the vicinity. If by means of these bunds the young trees could be induced to spread their roots into the crevices of rocks, it might be possible to clothe areas which at present look well-nigh hopeless.

As regards the differences between this method of reproduction and coppice, it might be suggested that coppice forms on an old stump and on an old root, both of which are liable to rot away; whereas from suckers, the exposed surface of the under-

ground branch need not be damaged in such a way that at the point of reproduction water would have a tendency to lodge and thereby rot the parent stock and it would form a root of its own at the same time as it form's a stem of its own. Again, whereas in coppice the new shoot comes up on the site of the parent stem, with sucker-shoots they would come up at various distances away from the parent stem, and tend to cover the ground in a shorter space of time.

For these reasons, therefore, it seems to me that a system of reproduction by sucker-shoots deserves closer attention than has hitherto been paid to it.

A. W. LUSHINGTON.

" The Woodman's Handbook, Part I."

THIS is Bulletin No. 36 of the United States Bureau of Forestry, by Professor Henry Solon Graves, Director of the Yale Forest School. It is unfortunately not available to the public at large, and is only issued on a very limited scale, because it contains a number of copyright tables, the use of which was only permitted on this condition. The first volume, which is of a comfortable pocket size, contains rules for finding the contents of logs and standing trees, contents tables, volume tables for different species, method of estimating timber, a brief outline of working-plans, and descriptions of forest instruments. The second volume will contain directions for studying the growth of trees, tables of growth, directions for the study of future production of forests, tables of future yield, and miscellaneous tables, of course, with reference to American species principally.

In the States the cubic foot is little used in practical work. The lumberman has been master of the situation, and all he has cared to know has been the number of running feet of planks obtainable from a tree of given size. Hence the origin of " board measure" and the existence of over forty " log rules " used in different localities. Each of these log rules is based on calculation or on actual experiment of the number of feet of planking obtainable from a given sample-log or set of logs, and no two of the forty can agree as to the number of feet of inch plank obtainable from a given tree, otherwise they could not all exist. When it is added that each rule has two or three different local names, some idea can be formed of the confusion. Many of these log rules are prescribed in the statutes of the various States, but lumbermen seem to conform to the statute just so long as it suits them.

The unit of board measure is the board foot, which is the contents of a board one foot square and one inch thick. So far so good; twelve board feet make one cubic foot, but regardless of waste. A further quite arbitrary deduction is made by estimate in case of defects if any exist. There is also frequently a unit of sale, called the "market" or "standard." This is a log twelve feet or thirteen feet long, and 19, or 21, or 22 or 24 inches thick at the small end inside bark, as the case may be. The utility of the " standard" is not clear. To the outsider it would appear that the hundred or the thousand of running feet would be infinitely less complicated. Only long pieces are measured by the foot cube when used for spars or square timber.

Firewood, small pulpwood, and material cut into short sticks for "excelsior" (whatever stuff that may be) is usually measured by the cord. A cord is 128 cubic stacked feet. If in 4-foot lengths, the cord is 4 feet high and 8 feet long. If it is 5 feet long the cord is 4 feet high and 6½ feet long. If it is pulpwood 5 feet long the cord is 4 feet high and 8 feet long. If cut shorter the cord is still 4 feet high and 8 feet long, but the price is cut shorter to match. A "cord foot" is an eighth of a cord, that is, 4 feet high and 1 foot long. A "foot of cord wood" means a "cord foot." A "surface foot" is as measured on the side of the stack. Cordwood is sometimes measured with callipers. Instead of stacking into cords, the average diameter of each log is taken, and the number of cords found from a table expressed in "cylindrical feet." The "cylindrical foot" is the same as the "stacked cubic foot," or the 128th part of a cord. The cubic contents in cubic feet cylindrical is found by squaring the average diameter in inches, multiplying by the length in feet, and dividing by 144.

The chapter on estimating standing timber is short but practical. The term "cruising" is used to denote the systematic manner in which the valuer extends his operations from one place to the next. Tally sheets are used instead of note-books. Several methods of taking heights are given and illustrated, together with various instruments used. There is a specimen map, and altogether the handbook will be one of the most useful and valued possessions of the American forester.

V.—SHIKAR AND TRAVEL.

The Long Round to England.

THE journey home from India by Japan and North America presents many lines of interest. The reverse tour has already been described in these pages in the last few months, from what may be called the social side, and no apology is needed for the following account, dealing mainly with the forests of the countries traversed; indeed, some description is due both on account of the exceeding courtesy and kindness which the writer received from the forest authorities, and of the interest of the many different forest scenes which passed rapidly before his eyes during the four months spent on the way. By personal explanations, by maps and pamphlets given with a generous hand, the authorities endeavoured to give a full, general but concise impression of forest conditions; but the areas and interests involved are vast, and the writer feels that he only entered the ante-rooms of huge buildirgs and that what he saw in them was only imperfectly focussed to his eyes.

"The photographs show a virgin forest of Cryptomeria Japonica and a plantation 8 to 10 years old of Cryptomeria Japonica and Chamcecyparis obtusa with a 40-years old plantation of Cryptomeria Japonica behind."

PART I.—THE FAR EAST.

FROM INDIA TO JAPAN.

Starting from Northern India, then, the journey to Tuticorin by rail through Bombay and Madras affords an interesting glimpse of the variety of the conditions of life in certain provinces and Native States, as also of the forest vegetation and its treatment, but it is not recommended at the end of March on account of the heat. Poona and Cuddapah were passed through at night. The scrub forests of Lalitpur and Madura are a pleasing contrast to those—or their remains—of parts of the Deccan. The instinct of forest conservation is instilled not inborn—is a truth which impresses itself incessantly on such a journey as this. Fortunate are those nations which, when their instinct is appealed to, still have valuable forests in their midst, for they can quickly grasp its value.

A three days' wait at Colombo for the North German Lloyd *Bayern* was pleasantly turned to account in a run up to Kandy and the Peradeniya Gardens hard by. After the vegetation of the dry hot plains of India, the luxuriant growth and the dense vegetation of the damp heat of Ceylon are a revelation. The soft-moulded Cinghalese also form a strong contrast to the men of Northern India. The Gardens are world-famous and well worth a visit by any one, whether botanist or not. Our voyage to Nagasaki was varied by stoppages at Penang, Singapore, Hongkong and Shanghai, the last three being of special interest and having their commercial prosperity stamped very plainly in their busy streets and population. At Singapore are good Botanical Gardens. At Hongkong the slopes of the Peak have been planted up with temperate species to a considerable extent. A two days' wait at Hongkong was sufficient for the highly interesting short trip to Canton, which should on no account be missed if the opportunity for making it occurs. The numerous narrow streets with deep open-fronted shops, of excellent quality and great variety, the river full of craft, the walls with their obsolete guns, and the Chinaman in his own home are the chief sights. One or two timber-yards were cursorily visited. All the larger building timber seen was of a fast-growing pine floated down the West River from some distance upstream in baulks about 15' × 16" × 18" or in the round. The houses are of grey brick, but there is much timber and bamboo work in them. Inasmuch also as fuel shops were seen alternating with the better class shops in the city, that trade is evidently profitable. The orders against the illicit cutting of trees in the neighbourhood are said to be strictly enforced.

Of Shanghai, the shipyards, the river front in the international quarter, the red brick suburban residences, and the poplars and willows which form a large percentage of the roadside trees remain engraved on the writer's memory. Thence the *Siberia* dropped again down the discoloured waters of the Yang-tse, and a

bitterly cold three-days' passage brought us to the first port in Japan, Nagasaki. Another thirty-six hours, through the Straits of Shimonoseki and the beautiful Inland Sea, and we were landed at Kobe.

JAPAN.

It is not the writer's intention to describe again the beauties of Japan. Hundreds of pens have attempted it. Suffice it to say that owing to the extreme kindness of the authorities in deputing an officer of high standing for the tour of twenty days, and to the untiring zeal and never-failing attention of the latter, a considerable amount of ground was covered between Kobe and Aomori in the north of the main Island, and all difficulties of travel and living were smoothed.

Our time was equally divided between town and country, in this case forests,—a course strongly recommended on account of the contrast of life and variety of scene presented. The town and city life, the ancient castles and palaces, the shrines and temples built almost entirely of wood, and in which some of the finest and most massive woodwork is to be seen, the narrow streets with their small wooden houses, the picturesque busy population are all strange, all interesting. To the European the charm of Japan lies in its nearness to the feudal past and the quaint ceremonies and other artistic reminiscences of that past, as well as in its beautiful scenery, while our interest is stimulated by the energy, too imitative it may be, and manufacturing enterprise by which the nation has brought itself up to a modern standard. Two opposite examples come vividly back to us—the cherry-blossom dance, performed in Kyoto, whose delicate but brightly artistic charm, together with that of the tea ceremonies preceding it, must be seen to be in any way appreciated, and, on the other hand, the extreme development of the telephone service in the principal streets of the commercial city of Osaka, partly no doubt on account of the want of locomotion other than pedestrian. As forestry in Japan is a sealed book to most foresters, our wish is to give here a general idea of the country in reference to its forests and of the work and organisation of the Forest Department. Of the forest areas belonging to the State, only those of the main Island, Nippon, and of Shikoku and Kinshin are under the Bureau of Forestry, whose headquarters are at Tokio. Those of the Northern Island, Yezo or Hokkaido, and of Formosa are under the authority of their respective Governors. The following remarks have reference to the first three islands, and especially to Nippon.

CLIMATE AND LOCALITY.

In its situation and relation to ocean currents Japan is well compared with the British Isles. The first is however considerably bigger in area, and owing in part to its greater length and want of compactness the difference in temperature between Yezo and Kinshin is large. Yezo is within the same isothermal lines

as the north of the British Isles and the south of Norway, while Kioshin and the southern shores of Nippon have Mediterranean temperatures. This agrees with the writer's experience of the strength of the sun in the first half of May. Walking in the valleys in Nippon then is less pleasant than riding in a rickshaw. The Japanese frequently use umbrellas in the sun in May, by no means the hottest month. The rainfall is large. In practically no part of the main Island is it less than 40 inches and in a considerable area it is over 100 inches. Where the State forests lie thickest it would appear to be generally between 50 and 75 inches. It is spread well over the twelve months. Japan has thus a fine growing climate for forests.

It is also a country of great undulations and high mountains. Corresponding with the ever-present hills is the depth of water close inshore, the passage of large steamers through the narrows of the Inland sea is a striking illustration of this. In the well-known book *Things Japanese* it is stated that only 12 per cent. of the land is cultivable, but the percentage within the three islands is probably larger. Be this as it may, the fact that 55 per cent. of their surface is estimated to be still under forest, though the large population of 40,000,000 Japanese is mainly dependent on the land, is sufficient proof of the mountainous nature of the islands. The geological features appear to be very varied. The western portion of the main Island is largely of tertiary or recent formations, with lower but still very considerable elevations. In the eastern and north-eastern parts, as a result of greater upheaval in conjunction with or as a consequence of gigantic igneous forces at work, the mountain ranges are higher, with many peaks of 6000 feet to 8000 feet and the older rock series have been more largely exposed. Within comparatively small areas the variations of the strata and rock formations are very great, metamorphic action having also played a large part. In this portion of Japan the now extinct volcanoes thrust themselves prominently before the interested eyes of the traveller, some of them being very fine. Such are the leading characteristics of the locality and climate, and grazing, as contrasted with the same in India, being almost nil, it follows that there are no hindrances to a soil covering of sufficient depth and freshness, while numbers of streams and rivers descend from the hillsides to water the rich cultivation on their lower slopes and in the valleys and plains of moderate area, which lie with few exceptions towards or along the seashore.

ECONOMY OF LAND.

The landscapes of Japan are invariably pretty and interesting, the first owing to the general features already mentioned and the second owing to the careful economy of land, especially culturable land, practised for many generations past. The largeness of the landscapes forms a somewhat curious contrast to the life of the Japanese, the chief characteristic of which is its minuteness both in the arts and in many other aspects. All the

culturable land is highly cultivated, and where possible irrigated by canals, wells or tanks, and in the warmer south two crops a year are taken off it. The mulberry is largely grown, and the bark used for paper and the leaves for the propagation of silk worms. As already mentioned, the greater part of the population is agricultural or rural. The picturesqueness of the country districts is much enhanced by the numerous pretty and neatly built villages; while the low lands hold rich cultivation, interspersed with bamboo plantations and in some parts with small wood-lots. *Speaking generally*, the low hills nearly adjoining the cultivation are covered with tree-growth and will be found of to belong to small owners, as is evident from the patchy aspect the hillsides, while the slopes of the mountains rising behind are used as grazing grounds and are bare of forest growth or else are clad with forest and belong to the State or large private owners. The quality of the woods belonging to small owners naturally varies greatly. On the whole they are young. Of those seen in Nippon, a large portion were of red pine, of middle or younger age and of artificial origin; there is also much coppice forest of mixed broadleaved species, oak, beech etc, on a rotation of about 20 years, and plantations of Cryptomeria Japonica are also common. Some of the young red pine woods are of the best quality. Near Tokio much of the culturable land in the plain is kept under such forest by private owners, owing to the big demand in the capital, and also without doubt to the low assessment on forest land. In the western part of Nippon on the sandy soils the pine forests on the hills are of large extent, but much denudation of the soil has been caused by the national system of clear cutting, which, however, is now being repaired to some extent by artificial regeneration. The State forests mostly lie in the northern part of the main Island, which is cooler and more mountainous. The lower slopes of the mountains are largely given up to grazing, large numbers of horses being bred in the north.

The land tax is $3\frac{1}{3}$ per cent. of the land value on cultivation, but the remainder, including private forests, is very lightly assessed.

The area of the three islands, Nippon, Shikoku, Kinshin, is about 120,000 square miles. Of this the forest area is about 65,000 square miles, of which 25,000 square miles is State forest, the remaining area being made up of a considerable area of Crown forest, some small municipal forests, areas belonging to the Church, and other private forests.

PRINCIPAL FOREST TREES.

Chief among the coniferous species in these islands are Cryptomeria Japonica (Sügi); Chamcecyparis obtusa (Hinoki); Pinus densiflroa (Aka-matsu, red pine) widespread; Pinus Thunbergi-(Kro matsu, black pine) chiefly along the shores of the Inland sea; Thujopsis dolabrata (Hiba), Abies firma (Momi). Among the

broadleaved species Quercus serrata (Kunagi) and several other oaks, and Fagus sylvatica var. Asiatica (Buna) form a considerable proportion of the coppice forests, and the latter mixed with conifers occurs in high forest. The most valuable species in high forest are Telkowa acuminata (Keyaki) and Cinnamomum camphora (Kusu-noki, camphor). The first grows to large dimensions (5 feet diameter, 100 feet height) on volcanic soil in mixture with oaks and has something of the appearance of beech. The *timber is considerably like teak in* appearance and quality. Camphor grows in Kinshin and in large quantities in Formosa. The timber is finely grained and grows to large dimensions. Of the conifers, Sugi, Hinoki, Hiba are all fine-grained timbers.

LIFE OF THE PEOPLE AND USE OF WOOD.

It is desirable to add a few lines on the life of the Japanese in its bearing on the forests and the forest question. A very large majority of the houses, both in town and country, are built entirely of wood with tiled roofs. The houses are small. The timber used is mainly coniferous—red pine for the poorer class and Cryptomeria and Thujopsis where the more valuable kind of timber is required. In the rural districts the roofing is often of bark, especially that of Cryptomeria.

The woodwork is simple and, except in the north, very neat and artistic and often beautifully polished. Strange to say it is almost all done by hand, there being only some five or six saw-mills in the country. The carpenters' tools too are decidedly primitive, the hand saws being very short and deep bladed. Much of the best woodwork of large dimensions is seen in the numerous Buddhist and Shinto temples, where large beams and pillars of Cryptomeria and Telkowa are seen being inspected with much interest by the Japanese.

Among some of the other principal uses of wood, barrel staves are split in the forest from pine and Cryptomeria, matches are made in Kobe from wood from private forests, tea-boxes, now being largely exported to Ceylon, and chopsticks are made of the wood of Abies forma. Shingles are also largely turned out. Little paper pulp is made at present, paper being prepared chiefly from mulberry bark and straw. Charcoal is burnt from twenty different species, including oaks, and is very largely used for heating and smoking urns. Clogs, which with grass sandals are almost universally used instead of boots, are made from the wood of Kiri, a fast-growing tree which is largely grown in open groves round villages.

The demand for wood of all kinds is thus very great, and at least in private forests there is a continual tendency towards lowering the cutting rotation. Partly no doubt this is the effect of the extensive cuttings which took place in the years succeeding 1868 (which are referred to again later on); and it is so in spite of the planting work to replace clear cuttings, both of which are parts of the national system or instinct of forestry. The

prices of timber are somewhat high, those of Cryptomeria and Chamcecyparis being roughly 6*d.* per cubic foot and pines about 3*d.* Railway rates are approximately ½*d.* per mile per ton.

GOVERNMENT.

As in other civilised countries, there is a central Government with offices or departments, and the heads of the latter are selected from the political party having the majority in the two representative bodies, the Upper and Lower Houses or Diets, and compose the Cabinet. The members of the Upper House have a more important share in the Government of the country than is the case with the House of Lords in Great Britain. The members of the Lower House are salaried. The Department of Agriculture and Commerce is represented in the Cabinet. The Bureau of Forestry is one of its branches. Two of the secretaries of the Bureau are present in the House during the parliamentary session to give information as it may be required.

Very important to the well-being of the rural districts and of the forests as a whole is the division of Japan into prefectures or ken, of which the three islands referred to here contain thirtyfive. The Governors of ken have important administrative and legal functions, with branch offices of various departments under their control. They have no jurisdiction over State forests. In only four or five of the ken as yet are there forest offices for "civil" forests; these are concerned with the management of experimental forests for the benefit of village communities and for the encouragement of planting or sowing by a free distribution of plants and seeds or the same on payment. In all prefectures there are now restrictions on cutting on sandhills or at sources of streams, but not at present very rigidly enforced. Conservators of State forests advise in this. A short description of prefectural schools for instruction in agriculture and forestry is given later on.

PAST HISTORY OF THE FORESTS.

In order now to understand the present condition of the State forests and their origin as such, as well as the evolution of the Bureau, we must go back a few years.

The retirement of the Shoguns and restoration of the Mikado to the actual government of Japan in the year 1868 is for the forests, as for all else, the critical point in the modern history of Japan. Up to that date there survived feudal Government under succeeding Shoguns, who, though in each case nominally the principal feudal lord, actually and hereditarily ruled the country for several centuries. Such a system was an impossible survival in these modern times, unless the country remained closed to foreigners, and when the United States and European Powers insisted upon it being opened to freer intercourse, the Shogun and the feudal lords (or Daimys), retiring from power, gave up all political and private rights of lordship, and a complete change and modernising of the Government came about, which is hardly yet

complete. *The laws had to be newly codified among other upheavals of old institutions*, and it was twenty years or more before the conditions of rights of property were finally settled.

The effect of such a sudden change on such property as the forests can easily be appreciated. Under the feudal system stability and a continuous policy were guaranteed, the forests were preserved with considerable care, and planting was practised, but so soon as restrictions were removed and they became common property, very heavy cuttings were made by neighbouring villagers and landholders in all within easy reach of the market.

It was in the year 1878 that the question of the reservation and administration of the national forest property first came into prominence. The prime movers were officials assisted by some public spirited men, among them the famous Count Yamagata, but there was much opposition from the villagers and other private interests. At that time the distinction was drawn between the private and State forests and somewhat rough maps were made illustrating these and their boundaries. Up to 1885 the State forests were administered by the Governors of Prefectures, and in that year the staff of management was first organised, twenty-one circles being formed and placed under the Department of Agriculture and Commerce. A first forest school for the training of rangers had been started in 1882 at Nishigahara. The important association of private owners and others interested in the welfare of the forests, the Forestry Society, came into existence about this time.

FOREST LAWS.

The necessity of enacting forest laws was quickly felt. The first draft was made in 1882 by officers who had returned from training in Germany, but it was too advanced for the general conditions of the country and the incomplete state in which general legislation then was, and thus the so-called common *Forest Law* was not promulgated until 1897. It deals with State, crown, private, municipal forests and those belonging to religious bodies, and places certain restrictions on the cutting and cultivation of those of the last three classes. Its enforcement lies with police and forest officers, who have powers of arrest and of taking evidence. The maximum punishment is two years' imprisonment or payment of double the value of the produce concerned. A second law called the State Forest Law, dealing among other things with the part interest of private persons in State forests, was enacted a year or two ago.

PRESENT ORGANISATION OF THE FOREST DEPARTMENT.

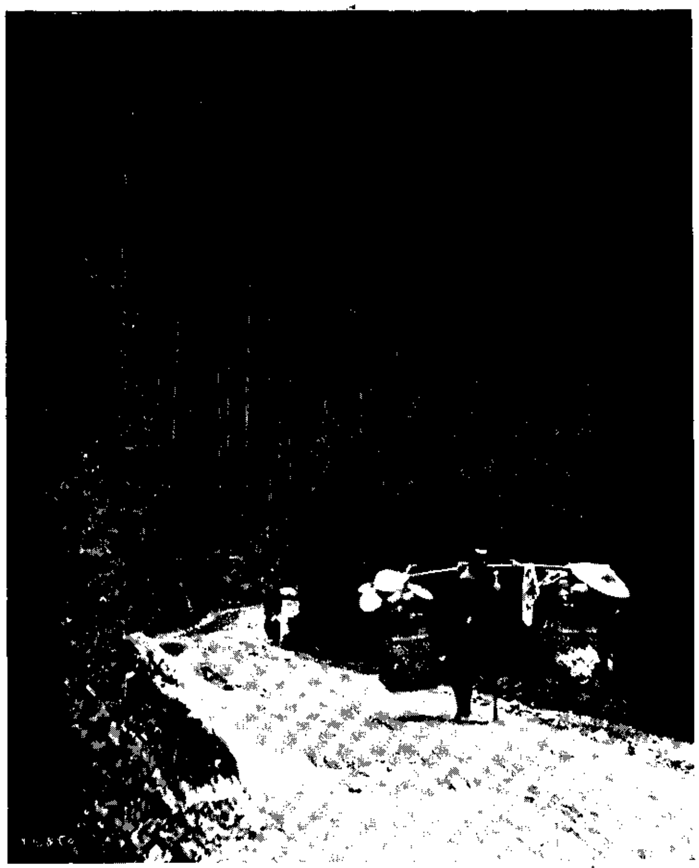
The organisation of the Forest Department in Japan and the management of the forests are based in the main upon the German model, but both are as yet incomplete, and the organisation is at present very central, mainly owing to numerous claims to forests and forest land put forward and not yet decided, and to the

want of a full-trained staff, especially in the subordinate establishment, and the difficulty in obtaining satisfactory recruits. In several respects the position is analogous with that in India nearly twenty years ago.

The Forestry Bureau or central administration is divided into five branches, each under a Director with twenty or more clerks, the whole being under the Director-General of the Department. The branches are those of general administration, accounts, forest works (survey, working plans, plantations, demarcation), miscellaneous (chiefly appointments and personal matters) and special claims. For a clear understanding of the state of things, it must be explained here that owing to the manner in which the old feudal system passed away and to the position and proprietary status of the Church, no fewer than 22,000 claims affecting 10 per cent. of the whole area of State forests were put in by corporations and private persons of all kinds, especially to the more valuable portions. The special claims branch, appointed five years ago, has dealt already with 12,000 of the smaller claims, and the Upper Diet has now ruled that all claims must have been first presented within the five years, 1868 to 1873, and must be supported by written evidence. But though the work has been thus far simplified, it is still extremely complicated, because adequate records are available from long periods of time, particularly in the case of religious houses. Many large interests are involved in these claims, the splendid old cryptomeria forest at Koyasan, which was visited by the writer, and which surrounds an ancient burying ground, being the object of one of them, but only about 6 per cent. of the decisions have so far been carried on into the law courts. This great work has been grasped by the authorities with their usual energy and affords an extremely interesting instance of the difficulties presented in evolving the new state out of the old.

The other abnormal feature in the organisation lies in the existence of certain small State forests which it is not desirable to keep as such, and in the method of their sale between the years 1900 and 1913. By this means a special account is obtained of £200,000 per year, which is spent in surveying, plantations, working-plans, demarcation and the establishments involved. The gross revenue from the common account or ordinary sales of produce from permanent reserves, which in 1885 was £ 35,000, was £ 200,000 in 1897, and has since increased; but the surplus is not large after paying for the ordinary executive establishment. Clearly, to complete and keep up some of the important special works, a second special account may be required after the year 1913. With regard to this, normal expansion of revenue may do sufficient, as it appears that forests not under detailed working-plans are not being fully worked.

As regards the forest works branch and its results in the office and in the field, rough working-plans were completed ten years



CRYPTOMERIA JAPONICA.

The largest specimens seen were estimated to be 5 to 6 feet in diameter and nearly 150 feet high and several hundred years old; as forest trees a diameter growth of 3 feet and height-growth of 100 feet are general limits in old natural woods. Although some of these fine old woods remain in the north or as appurtenances of religious houses, the very great majority of the Cryptomeria woods now standing have been planted. In the old woods seen in the Akita conservatorship the canopy, is on the whole of fair density and the trees are branched somewhat low down, and the absence of natural reproduction is very striking. This may be due to the extreme wetness of the soil covering. The root system is very shallow. In the natural woods, the mixture of other species with the Cryptomeria is very small. Abies firma is one of them. In Akita much reproduction of a Cephalo taxus sp. (dwarf yew) was noticed. The woods in Akita are now being treated under a rotation of 100 years, under which a maximum diameter growth of 2 feet and mean growth of 1 foot 8 inches is expected. Private forests are treated on a rotation of 60 to 80 years. The Cryptomeria forests, like most other coniferous forests, are subjected to clear cuttings: the point to which this system is carried in Japan on steep slopes opened our eyes very wide. Taken as a whole, the results are very excellent, except in the pine forests on sandy soils already noticed, where a rational system is required badly.

In the Cryptomeria forests seen, the area of a clear cutting on steep ground was probably nowhere more than 15 acres.

These Cryptomeria forests are replanted mainly with C. Japonica and Chamcecyparis obtusa (Hinoki). The latter is planted in the poorer soil and on the ridges, the former in the hollows and damper ground. In middle class soil both are mixed. The Cryptomeria naturally grows the faster of the two. In districts in which thinnings sell well the plants are put in very closely—at 1 metre interval, subject to good quality of soil in the planting spots. Transplants of the 3rd year are planted one year after felling. Thinnings commence early, from the 12th year, and are at first frequent, the first thinnings being sold for walking sticks. The young woods have the appearance of being heavily thinned. Rope and sticks are freely used to support weak stems against snow! A 30 years' old plantation of pure Cryptomeria of good quality was estimated to have 400 stems to the acre of an average height of 45 feet and diameter of 8 inches or 9 inches.

In some well-known woods belonging to an owner of advanced ideas, a large and highly successful plantation was seen which had been made recently on an upper grazing ground leased for one rotation from a village. Where the woods are favourably situated no part of the Cryptomeria tree is wasted. The root wood and branch wood is exported, the former being used for barrels and roofing, while the twigs and needles are used either for fuel or as a fertiliser in the plantations, being spread over the soil.

THUJOPSIS DOLABRATA.

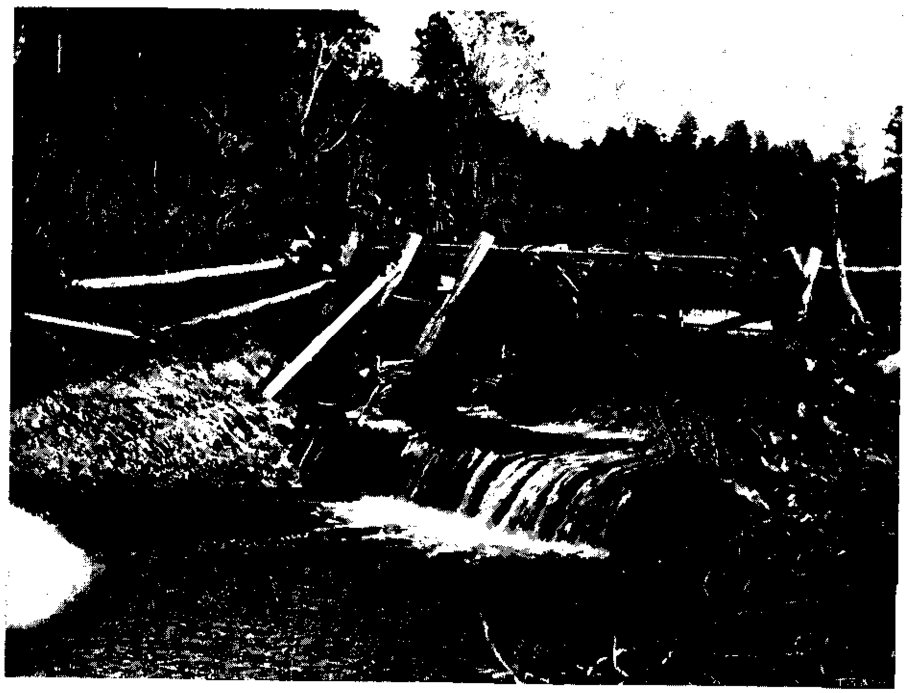
Another interesting trip was one made to a natural forest of Thujopsis dolabrata (Hiba), a beautifully smooth-grained timber lasting well under water. The Japanese Beech is largely mixed with the Hiba at the upper elevations, but its timber is only just coming into use, and it is being cut out and Hiba planted instead. The forest was heavily cut over under the prefectural régime, but was protected before 1868. The Hiba grows up to about 90 feet on good localities, the most suitable soil being that derived from pure sandstone. The forest is being treated under the selection system. Natural reproduction is moderate, and where not sufficient, branches are cut and planted either just before the snow falls or after it melts. As the snowfall is very heavy, cutting is done after it is completed and has hardened, and it is dug out round the trees to be felled. The stumps left are cut again in the spring. Plantations of Hiba are of about the same quality as those of Cryptomeria Japonica.

EXPORT.

The export arrangements in Japan present no novelties except the dams shown in the above forest. These dams are made of timber and earth, and the sluice-gates consist of two sets of planks laid loosely longitudinally and one above another to form the gates; the outer end of each plank is tied separately by rope to the side of the dam, and the inner ends rest against a pole slanting slightly inwards towards the pond and also tied above to the dam. This pole is wedged in position by another thinner pole, so that when the pond has been filled with water and logs and the latter pole is pulled out, the remainder of the gates swing free and water and timber pass on to the next dam perhaps a mile further down. In this way the water in the small streams is used to the greatest advantage when the timber is being exported in the spring. The writer was very kindly given the opportunity of witnessing the working of these dams.

THE FUTURE.

A word as to the future. Japan is essentially a great forest growing country. If all the possible culturable land or that required for pure grazing is taken out, a very large area suitable only to forest remains. Furthermore, the "leads" to the sea are short. Its future therefore as a great timber exporting country seems absolutely certain, as China alone will absorb all the timber offered to her. For the present Japan will probably find the machine cut wood from the Western States of America competing severely in the markets with her products, and besides she has not or ought not to have much to offer. At present too, the Bureau of Forestry has its hands full with the setting of its house in order, but it must eventually, perhaps after long years, become one of the most important departments in the Government, both as controlling the destiny of a large portion of State property and



A Dam.

as the leader or expounder of the best policy for the working of the very large areas of private forest in Japan.

It is the pleasure of the writer to place the information as kindly given him before the readers of this magazine, hoping that it may add to the interest aroused in all who visit the delightful home of our allies the Japanese.

The Bison

As an old shikari, I read with interest the remarks of "Solid Lead" about the Bison. Rifles have changed since my time, but the bison has not, and perhaps the following account of an incident that happened to myself may be of some interest to your readers.

It was about the end of April or early in May 1863 that I was prospecting for the Boree Forest Reserve, and my work took me on to the low hills which extend from the Sonebudi Gorge westward to the Machna. It was late in the afternoon and I was not in quest of game, but had with me an old double *Westley Richards* rifle, 12-bore, which carried a belted ball and not more than 3 drachms of powder. It was not a powerful weapon but good enough for a chance shot at a sambur or such like animal. Going along I came on the track of a considerable herd of bison, and noticing that a solitary spoor left the rest and went towards two or three small conical hills close by, I followed it up. I crossed the neck between two of them, and was going down the slope on the other side, when a large bull bison got up and stood some 20 or 30 yards in front of me. I got my rifle and fired at the joint of his shoulder. At once he came straight at me *with his head down*. Of this I feel quite sure even after the lapse of years. I gave him the other barrel, which did not stop him at all, and swung myself up into a small tree that was close by, and the bison passed under my legs. Just at that moment my syce crossed the neck and was coming down the slope with my pony. He let go the pony, which bolted across the neck, and fled. The bison caught him fair behind with his nose and pitched him a good half dozen yards, and without stopping bolted across the pass and escaped. The man was not really hurt at all, beyond bruises and a scalp wound of no importance. But in attending to him and getting water time passed and the night fell, so I never saw the bison again, but his tracks showed that he had joined the herd which moved off altogether. The whole thing from first to last did not occupy two minutes, but I have a perfect recollection of it, though it happened so long ago.

Now the question arises, did the bison really charge me? Or was he only using his natural way of escape to join the herd? Forsyth, who alludes to the occurrence in his *Highlands of Central India* always maintained that it was no real charge. Beyond the fact that he came at me, with his head down, I cannot positively say. Perhaps "Solid Head," who certainly knows something about bison shooting, will kindly give his opinion.

G. F. PEARSON.

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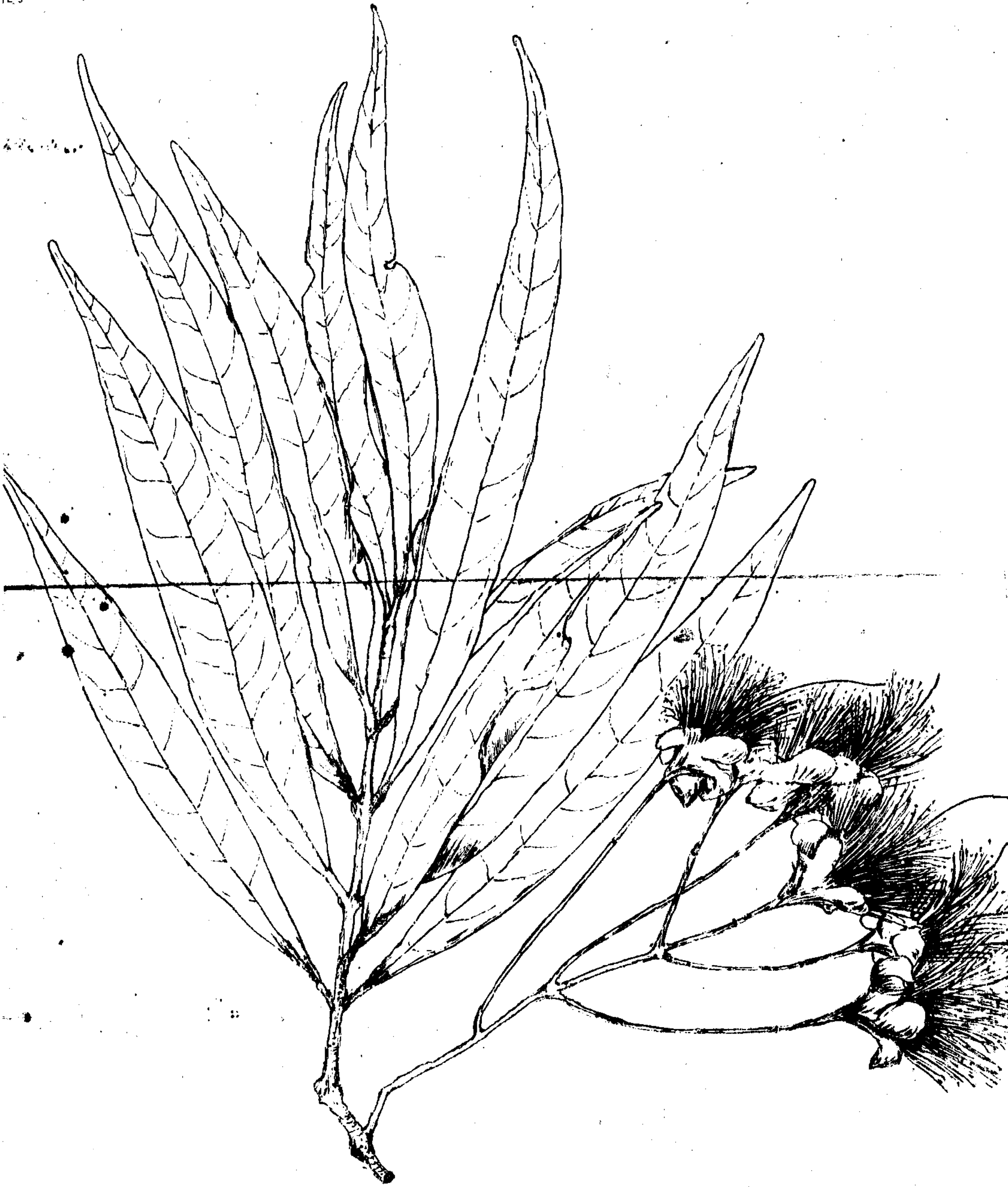

EUGENIA OCCIDENTALIS, BOURDILLON

.. Bourdillon dell.

A. P. Cortez & Co. Lith.

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Eugenia occidentalis—a new Species communicated

BY J. F. BOURDILLON, F. L. S.

MYRTACEÆ.

Eugenia occidentalis, sp. nov.

Leaves 5—7 in. by ½—⅝ in. opposite, entire, linear-lanceolate, tapering to both ends, thinly coriaceous, venation indistinct. Petiole stout, ¼ in. Flowers white, 2 in. across, in terminal and lateral cymes, on long pedicels, calyx-tube white ¾—1¼ in. long, funnel-shaped, lobes 4, ovate-oblong, petals 4 white on a broad claw, stamens white, very numerous and very thin, 1½—2 in. long, style long and thin. Fruit not seen.

A small tree only found hitherto in the forests on the banks of the Periyaur River in North Travancore. Flowers January—April.

In the Kew Herbarium there is a specimen collected by Wight and marked Cochin,—April 1849. In all probability it was obtained from the same locality as the specimen figured. [See Brandis' "Indian Trees," page 319.]

Strobilanthes and Natural Reproduction.

BY B. B. OSMASTON, F. C. H.

One of the characteristic features of the undergrowth in the temperate or middle-hill forests in the Darjeeling Division is the dense thicket formed by a shrubby species of *strobilanthes* (*S. pectinatus, T. And*) which covers extensive areas to the exclusion of all other undergrowth, especially on Northern and Eastern aspects, under the mixed forest of oaks, chestnuts, magnolias, and laurels.

This shrub flowers periodically, and then dies. This happened over the greater part of this Division in 1890, and again in 1902, showing that the life of a generation is 12 years.

Like most of its congeners it yields a good fodder, and the dry stems burn well, and are collected on a large scale by the poorer inhabitants a year after the death of the plant.

It usually attains a height of about 10 feet with a girth of 9 inches, though larger individuals may often be seen, and I have a specimen 15 inches in girth.

It affords an exceedingly dense shade, in spite of which seedlings of most of the more valuable timber trees are able to persist beneath it, and having done so until the periodic seeding they get a chance of keeping their heads above the new generation of the strobilanth.

The weak point in the regeneration of the forest, however, shows itself the year after the death of the strobilanth, for at this stage the cattle (and most of the forests in question are subject to grazing) find their favourite fodder gone, with the natural result that they turn their attention to the few tree seedlings which may happen to be on the ground, and devour them.

The remedy which at once suggests itself is to close the forest to grazing for a couple of years or so after the seeding of the strobilanth, but unfortunately this is at present impracticable. An experiment was made in 1902, which consisted in cutting the strobilanth over an area of 6 acres in the month of June, when it had commenced to flower.

The experiment proved successful, and the strobilanth was practically exterminated on the area treated. It is, however, I think, doubtful whether much would be gained by the wholesale extermination of this plant for the reasons explained above.

Another shrubby species of this genus (*S. Helictus*) which is also gregarious, but of less importance owing to its comparative rarity, also flowered and died in 1902.

I can find no record of any previous flowering of this species, and consequently its " period " is not known.

It is a very handsome shurb with its zig-zag spikes of pure white flowers.

While on the subject of *strobilanthes* it may not be out of place to recall the fact that *S. wallichii*, which is such a pest in the karshu oak and fir forests of the Jaunsar Division of the School Circle, flowered and died in 1894 (I had the good fortune to be a witness of this, and a finer sight than the blaze of purple blossoms I have rarely seen). The " period " of this species being also 12 years, it follows that it will again flower in 1906, and it will be in the summer of that year that any steps to exterminate it might most profitably be undertaken. Should a campaign against this species be decided upon, I would suggest that the leafy branchlets (which alone bear flowers) should be sickled off in July or August over the areas taken in hand. This could be cheaply and rapidly done at a cost, I should say, not exceeding 8 annas per acre.

Flowering of Bambusa Polymorpha.

BY TAW KWÈ.

In spite of the sure signs seen by a late Conservator in Burma, this flowering has been somewhat delayed, and we are still waiting and writing. However, I suppose the flowering will come in

due course, and the writing may then cease, and then we shall see a first-class blaze of the *Kyathaung* Forests (it is too much to hope that the files will go too), as I do not believe it will be possible to keep fire out of such forests. It is true I have only experience of one Kyathaungwa Division,—Pyinmana, but I shall be most astonished if any of that escapes except the *Indaing* and evergreen. When the *Kyathaung* flowers there, those reserves are honeycombed with villages and foot-paths; each path will be blocked with fallen stems, and the Burman will want the paths cleared, and, what's more, he will see they are.

Now I see Kwe-tu-wet-u has been writing that we shall have to make our fire lines more elaborate, that means we shall spend more money, harass some Divisional Officers more than usual, but with the same sure result, *i.e.*, the clean sweep of the area by fire, and a jolly good thing too, for good-bye to any teak reproduction of any sort in any forest in which at least 75 per cent of the bamboo seed is not destroyed by fire, for in unburnt forests the young bamboos will be so thick that a bison will be hardly able to force his way through, let alone a teak seedling; and moreover, if the fire does not sweep through the first year, it will the second, with a bigger blaze, only not so beneficial, as the young bamboos will then be up.

Do any of your correspondents realise that the teak tree in Burma has come through many flowerings of the Kyathaung? And with remarkable success, too, to judge from what Pyinmana must have been like before it was an organised British Forest Division, therefore why not copy what was a fairly successful treatment? adding what we are sure will be beneficial, *i.e.*, when we have got rid of the shade of the bamboo which is *the* enemy, see that that shade does not get again half so dense in the future; and in my opinion that is the point. We don't want to eradicate the bamboo, for then we get "kaing," but what we want is fewer bamboo clumps, fewer alagahbins and more teak. Now to get this I would burn every forest where the bamboo has flowered and choose certain selected areas where teak is scarce or absent. I would sweep the bamboo seeds into heaps first, and then burn them more thoroughly than the rest; this will destroy a certain proportion of the jungle wood trees, and then in these areas, which should be as large as you have teak seeds sufficient for, dibble in teak seed in lines.

I may be an ass, my plan, however heterodox, is simple, it may be a poor thing but it is mine own, and I believe in it more than all the elaborate plans which I see mooted, and I pity the poor *Kyathaungwa* Divisional Officer who with an inadequate staff attempts to carry some of them out in his Division of 10,000 square miles.

Fertility of Seed from Sal Coppice Shoots.

By C. E. C. Fischer, Deputy Conservator of Forests.

"......... No coppice poles to bring forth infertile seed from the borrowed vitality of the parent stool."

"It will, moreover, be found to be a general rule that seed formed from coppice shoots is infertile ...."

These two statements will be found on pages 3 and 10, respectively, of the "Notes on Sal Forest," by Mr. Eardley-Wilmot, published as an appendix to the issue of the *Indian Forester* for June 1899.

It is with diffidence that I approach this subject, and my excuse is that it is one of very considerable importance when considering the treatment of sal forests, as the statements above forbid of sal being worked as pure coppice.

Does the verdict that seeds from coppice are infertile apply only to such shoots as are produced on a stump some distance above ground, and whose life is consequently concurrent with that of the old root stock, or does it include such coppice shoots as, springing from ground level, or even lower, are enabled to form their own root systems and eventually become detached and independent? In either case it would be satisfactory to know whether the opinion is formed from general observation only or based on specific experiment. From a small and perhaps not quite conclusive local experiment I am compelled to believe that seeds from sal coppice can be fertile in Ganjam.

The deduction from this experiment, even if reliable, I do not by any means thrust forward as a refutation of the infertility theory formed elsewhere. It is quite conceivable that, under the law of natural selection, sal here, in its southernmost limit, should produce fertile seed from coppice shoots, whereas in the centre of its habitat such seed should be infertile.

In the latter localities seedlings from coppice shoot seeds might originally have been weaker, and therefore less fitted for the fierce competition for existence, than seedlings from standard seeds, and this would tend to produce infertility. On the outskirts of its spread, however, reproduction frequently, no doubt, is mainly dependent on seeds from coppice shoots, and therefore their fertility would be fostered and fixed.

Moreover, it is well known that the quality of fertility is most delicate and is extremely liable to variation from change of climate and surrounding conditions, and there can be no question as to the very different conditions met with by sal in Ganjam and in Oudh or the Dun: for instance, there is no frost to be encountered here, the lowest temperature ever recorded, as far as I am aware, being 39° F. The above suggestions are, however, purely speculative.

As regards the local experiment already referred to, it was entered upon because of the references made to the statements that head this note.

Last May the four Rangers in the sal tracts of Ganjam (Gumsur taluq) made separate experimental sowings. Each officer collected and sowed in separate boxes or baskets seeds from standard trees and coppice poles. From 30 to 60 of each kind of seed were put down by each officer, and the earth provided was neither manured nor specially prepared, and was, in the main, inferior to the soil in a good sal forest where humus has been allowed to form.

The seeds were sown between May 25th and July 7th, and began germinating on an average for standard seeds in 8½ days and for coppice seeds in 7¾ days. The total number of seeds sown was 170 of each kind; 48 per cent of the standard and 40 per cent of coppice seed germinated. There was no apparent difference in the vigour of the seedlings of either description.

The seeds were collected without reference to the soil the parent trees were growing in, and further experiments on a larger scale must be carried out separately for seeds from trees on the various descriptions of soils and sown in various soils.

It may be of interest here to note that the seedlings reflected in a small way in many cases the actual features of their growth in the forest, with regard to the annual checks they experience until the taproot has reached the permanent water level. In one case the box used contained earth to a depth of 4 inches, and the stems of all the larger seedlings were found to have died off when they reached a height of about 6 inches. This occurred when the taproot reached the bottom of the box, immediately above which the root was suddenly narrowed. On reaching the bottom the root was diverted at right angles and grew along the horizontal floor. In nearly every case fresh shoots had been formed on the stem below the dead portion and also one or two buds on the root a little below the collar.

On Certain Important Forest Questions.

It was with much regret and not a little indignation that I completed the reading of Mr. Gamble's letter on this subject in the November number of the "Forester." From the pen of a less eminent man many of the remarks might safely have been ignored, but Mr. Gamble's opinion carries far too much weight to allow the adoption of that simple course.

Mr. Gamble has earned the respect and admiration of every officer in the Department, but in the present instance I think he would have been better advised had he made a little more sure of his facts, before rushing into print with such sweeping and in a large measure undeserved, criticisms.

I know practically nothing of India, but I do claim some knowledge of Burma and the difficulties which confront the Forest Officer here. That we are making no progress I most emphatically deny, and I think that, when all the circumstances are taken into consideration, we are, on the whole, doing fairly well.

For myself I admit that, in many ways, we are very backward, but whether we could progress faster than we are doing must be a matter of opinion based on a knowledge of all the facts and conditions.

I propose to describe a few of these conditions and then to reply a little more in detail to some of Mr. Gamble's charges. In doing so I will be as brief as possible.

It must be remembered that divisions in Burma are of huge size, and, as administrative charges, very unwieldy. Also, that we have very little trained establishment, and that the untrained establishment is, with few exceptions, wholly unreliable and absolutely useless for works of improvement.

The Pyinmana Division, of which I am at present in charge, is the one to which most of my remarks will refer, and as regards establishment and general conditions it is considerably above the average. Its area is, in round numbers, 7,000 square miles. There are 1,040 square miles of reserves as well as a large area of unclassed forest. There are five ranges, of which three contain 1,000 square miles of reserves—an average of 333 square miles per range—and all three contain considerable areas of unclassed forest in addition. The range officers are:—

Two 5th grade Rangers untrained.

One 6th grade Ranger (officiating only).

Two Deputy Rangers whose substantive appointments are in the 3rd grade—both untrained.

The average area of a Forest Guard's beat inside reserves is more than 50 square miles, and outside very much larger.

Regular Working Plans have been prepared for 1,030 square miles of the reserves, though all have not yet been sanctioned.

Omitting works that can be more or less carried out by the Range establishments, such as girdling in unclassed forests, repairs to demarcation, repairs to rest houses (we have 26 in the division, and build more yearly), making of plantations and weeding and tending of those already existing, fire protection (about 430 miles of fire lines), dibbling teak, climber cutting, marking of timber in course of extraction by lessees and contractors, etc., etc.; the plan of operations for the current year includes the following works which are based on the prescriptions (already in arrear) of such of the working plans as have yet come into force, and for which trained officers are necessary:—

(*a*) Girdling of 7,541 teak trees in reserves.

(*b*) Improvement fellings over 18,000 acres.

(*c*) Making a road 5½ miles long, costing Rs. 18,500.

(*d*) Selection and marking of 3,000 pyinkado trees for the departmental working of sleepers.

(*e*) Aligning and preparing estimates for two roads aggregating about 15 miles.

(*f*) Examination of forests for further reservation.

To cope with this there are three trained officers available, *viz*:—The last joined Assistant Conservator (just arrived), a trained Dehra Dun Ranger, and myself.

It is scarcely necessary to say that the general control of a division like this does not leave the Divisional Officer much time to carry out personally any of these works, especially as in the present year he has to prepare a rough working plan for a forest 10 square miles and assist in the settlement of three proposed reserves. Add to this that during Improvement fellings over *several thousand acres previously* carried out in the division the area worked over per day averaged less than 30 acres, and it will not surprise any Forest Officer to hear that much of the work must remain undone.

Mr. Gamble's charge, I take it, is that we have made no progress, and that this is due to the apathy (or something worse) of Forest Officers in Burma. We can no more carry out improvements without the necessary trained establishment than the Israelites could make bricks without straw. When we can obtain the establishment we shall be able to carry out more improvements. Until then we have to do the best we can, however disheartening the process may be.

Now for a little more detail on some of the points mentioned by Mr. Gamble, who writes that he thinks he is right in saying that in Burma, at the present time, Forest management is too much subordinated to the production of revenue. Further on in the article the report of the French Consul at Rangoon is quoted, and the inference Mr. Gamble obviously intends to convey is that the teak forests are well on the way to be worked, out and that this is due to overworking sanctioned, if not actually carried out, by the Forest Department. Had Mr. Gamble said that the Forest Department in Burma is crippled by a policy which subordinates forest management to the production of revenue, I should have been less inclined to disagree with him. As it is I am not cognisant of all the circumstances governing the policy and not competent to form an opinion on that point. I may add that I don't think we should have much difficulty in respect of money for improvements if we had or could obtain the necessary establishment to carry them out.

The charge is a serious one, but I think not difficult to refute. Many of our forests have been overworked, especially in Upper Burma, but we can scarcely be held responsible for what happened before that country was annexed. The same is the case in India, and I never heard of any country in which forest conservancy was introduced before considerable damage had been done in this way.

For many years past a large proportion of the teak arriving in Rangoon has come from Upper Burma, and up to the end of 1900 this division probably supplied more than half that

quantity. A fair estimate of the average annual outturn from the Pyinmana Division would be 50,000 to 60,000 logs (in one year the number was more than 1,50,000), and the higher figure is probably more accurate than the lower. Counting from 1887 only, so as to allow for resumption of work after the war, this gives a total of 7,00,000 to 8,40,000 logs. Assuming two logs to a tree (the ordinary average for recent girdlings is 3 logs to 2 trees, but many of those extracted during the later years of the lease were short) we have 3,50,000 to 4,20,000 trees. I am sure it will both please and surprise Mr. Gamble to hear that very few trees indeed were girdled between the annexation and 1899, when girdlings under regular working plans were commenced. I doubt very much if the total number was 5,000. I joined the Department in Pyinmana in January 1892, and I know that since then only a few trees previously imperfectly girdled have been killed under authority. I know also that girdling was stopped in the early years after the annexation, because it was so obvious that there was far more dead timber available than was necessary to supply the requirements of the lease.

Thus, practically the whole of the enormous outturn resulted from windfalls, deaths from natural causes and (principally) from trees girdled before the forests came under control of the Forest Department. The lessees paid a very small royalty, and, naturally, towards the end of their lease, they extracted a great deal of inferior timber previously rejected. Considering all this it is not difficult to explain the decrease, &c., mentioned in the French Consul's report, and Mr. Gamble's fears that the Burma Forest Officer s' energies are altogether devoted to ruining the forests under their charge are unfounded. We are proud of our forests and of the high revenue they produce, but we derive no direct benefit from it, and one can scarcely conceive that Mr. Gamble is serious in attributing to us actions and motives so childish and ignoble.

A large revenue is, in Burma at any rate, not incompatible with improvements, and our forests are far from being ruined. Mr. Gamble may rest assured that when girdling is carried out sylvicultural considerations are not ignored. The placing on the market of mature timber is just as important as any other of a forester's duties, and there are many mature and over-mature trees still available. In almost every compartment girdled over, trees 15, 16, 17, and even 18 feet in girth are obtained, and the figures are now available for the girdlings made during the first sub-period under the first Working Plan to come into operation. The average volume is 80 cubic feet per log, or about 4 tons per tree. This proves that we are not depleting our forests of small trees, and the fact that sanctioned Working Plans are in operation must be a guarantee that other considerations have not been lost sight of.

It is true that there is an enormous area of reserves for which working plans have not yet been prepared, but 'Rome was not built

in a day,' and the outturn of the eight sanctioned Working Plans parties may be expected to amount to about 1,000 square miles per annum.

It is also true that many of the most northerly teak forests have never been worked up to their full capacity, and some of them are still practically virgin. If the amount of teak now being extracted is comparatively small, it is because we are proceeding slowly and cautiously, and a considerable increase may be expected in the next few years. Indeed, it is more than probable that within the next ten or twenty years the amount available for export will be almost, if not quite, as large as it ever has been.

We are gradually working up to the highest yield our forests are capable of sustaining; and if we are proceeding too slowly, it is a fault on the right side. Though Mr. Gamble apparently doubts it, we are perfectly aware that it may take 150 to 200 years to replace a tree which can be cut down in a few minutes.

"The selection, demarcation and settlement of permanent reserves, a work which, elsewhere, is completed or nearly so, is still very much behindhand in Burma." If by this is meant that there is still a great deal to be done, it is perfectly correct, but it is rather unreasonable to compare a new country with an old one and the huge divisions and small establishments in Burma with provinces in which conditions are more favourable.

The areas of reserved forest in Burma were as follows:—

On 30th June	1901	17,836 spare miles.
Ditto	1902	18,606 do.
Ditto	1903	19,709 do.

The following are quotations from the Local Government Resolution on the Forest Administration Report for 1901-02, the latest available:—

"The area of reserved forests was increased during the year from 17,836 to 18,606 square miles * * * * . Reservation is being steadily pushed forward."

"The formation of new reserves is being closely followed by demarcation. The total length of additional work amounted to 1,217 miles, and 610 miles of boundary now await demarcation."

"Fire protection * * * is in a backward condition, many officers expressing openly their disbelief in its utility."

This, of course, is a big question and one of the utmost importance to Burma. I propose to make a few general remarks on the subject; but I cannot see how this or any other doubtful question can be correctly decided unless Forest Officers *openly* express their opinions.

It is very noticeable that the strongest advocates of fire protection in the Burma teak forests are almost invariably men who do not know them or who have little or no practical experience of the effect on them of fire protection.

We want more facts and figures before we can prove definitely that fire protection is harmful, but no one can inspect and compare areas burnt every year with those in which protection has been successful for some years without doubting its utility in respect of teak, especially in the moister forests. It is no argument to say that because fire protection is beneficial in pure forests, it must necessarily be beneficial in mixed forests, in most of which one species only is saleable, and that one with considerable fire-resisting powers, nor that because it benefits most species, it must necessarily benefit all. Ignoring other considerations for the moment, if fire protection is beneficial, why is it that teak grows faster in unprotected than in protected forests? Measurements of marked trees made yearly during the last 12 years in this Division show this; but the number of trees measured is too small for the experiment to be considered conclusive. A reference to page 529 of the latest edition of Mr. Gamble's 'Manual of Indian Timbers' will, however, confirm the result indicated by the measurements.

The opinion that fire protection is harmful in our teak forests is steadily growing. There is of course a great deal to be said in its favour; but as we usually commence our service, convinced of its value, the change of opinion with increased experience is significant.

It is claimed that fire protection has a very adverse effect on teak reproduction, and if this is so, the longer the protection lasts and the more successful it is, the more accentuated will that effect become, and the harder must be the struggle for teak seedlings that do appear.

In my opinion the operations most urgently required in the teak forests of Burma now are those known as Improvement Fellings; and forests in which these are carried out must be protected for a year or two before and for a few years afterwards. At the same time Improvement Fellings while greatly helping the existing stock cannot be depended on to assist reproduction or to lessen the struggle for existence of the future stock; and if it can be proved (which I don't doubt) that the effect of fire protection on reproduction is as disastrous as it is represented to be, no amount of damage by fire can justify protection. That, I imagine, is the position at present, and considering the importance of the matter, to say nothing of the vast sums we are now spending on fire protection, it seem advisable to lose no time in obtaining further information either by the appointment of officers on special duty or otherwise. It is quite possible that we are actually damaging our teak forests by fire protecting them.

We are obeying orders and extending fire protection, but sufficient labour is increasingly difficult to obtain, and there is little probability of increasing the proportion successfully attempted. The operations require the constant attention of every subordinate who has anything to do with the protected areas (particularly of the ranger) during the whole of the working season,

and other matters have as a natural consequence to be neglected. Of 5,412 square miles attempted in 1901-02, 4,979 were successful; but results in 1902-03 were much worse. I have not yet seen the figures, but if we are to protect, further extension should depend on the successful protection of areas already attempted.

I have alreay written at far greater length than I originally intended, but I cannot conclude without a few more remarks.

The necessity for sending officers to Burma to qualify for promotion must be a matter of opinion, but there can be uo doubt that conditions here differ greatly from those in India, and Mr. Gamble has made no allowauce for this. Most of us have suffered considerably in recent years owing to a number of senior officers having been transferred from India. This may or may not be unavoidable, but its effect on promotion is decidedly unpleasant for Burma men, who already lack many comforts and advantages enjoyed by their confrères in India.

We admit that in many respects Burma is backward, but the reasons given or inferred by Mr. Gamble are as absurd as they are untrue. He finds fault with Sir Dietrich Brandis for 'careless writing,' but his own letter shows little evidence of care in ascertaining the true state of affairs in Burma; and, as he himself tells us, *careless writing is only harmful and dangerous.*

Fair criticism cannot reasonably be objected to. Mr. Gamble's criticisms are ny no means fair; and we shall be much more grateful to him if he will tell us where the additional trained assistance we undoubtedly require is to come from and how it is to be obtained.

S. CARR.

Fire Protection in the Teak Forests of Lower Burma.

"The Indian Forester" for December contains an able article by Mr. H. C. Walker, for which I for one beg to thank him. Still I cannot help smiling at the calm assurance, or ingenuous brass, with which he proceeds to lecture me on "caution." It is just because I am extremely cautious in matters scientific that I refused to swallow whole his indiscriminate advocacy of fires in forests. I characterised his cocksureness on debatable points as "pernicious," not because I am myself cocksure that he is wrong, but because his thesis has yet to be proved, and because it was stated in a manner only too likely to afford the ignorant a chance of dividing our house against itself. There is a charming amount of assurance, too, about his claim to be the old established orthodox church, the policy of fire protection to be the new-fangled heresy. He should surely know that all the world over (except perhaps by the Burmese) fires are and have always been the recognised enemies and destroyers of forest. If therefore the case of Lower Burma is special (as it may well be) it behoves him not to preach caution to his seniors, but to explain very precisely and clearly the

conditions under which, and the localities in which, fires may be considered advantageous to forests. This he has not yet done, probably because he does not know and cannot imagine any Indian forests differing from those of Burma.

Mr. Walker has given cultural facts and arguments which I am willing to accept as in the main fairly correct for some locality and certain conditions somewhere in Lower Burma. But if he intends to imply that they are of general application, I put my pen through many of them, one after another. I cannot pretend to take his paragraphs *seriatim*, for it would fill the *Forester*, but the first thing that strikes my eye turning over the pages is the contention that fires do not cause hollowness in the subsequent coppice shoot because the taproot is discarded at an early date, and with it the few germs of decay disappear. This is a question of fact. I do not know whether he imagines that a plant can discard its roots as easily as a long suit in spades, but I imagine that, if he will take the trouble to dig out a lot of teak seedlings repeatedly cut back by fires and open them, he will not find one of them sound, while a teak seedling that has never been injured will be perfectly sound.

There is no such thing as a "prejudice" in favour of fire protection. It is admitted and proved up to the hilt that fires are ruinous to forests in America, Africa, Australia and India, besides Europe. Mr. Walker might walk from Bombay to Surat and Khandesh *without finding a single sound teak seedling*, and very few young teak seedlings of any kind. The forests are burnt every year, sometimes twice. I therefore beg Mr. Walker to give us a little less lecture about "caution" and pharisaical attitudes and more precise details to justify the exceptional position he adopts. Details of climate, soil, rainfall, situation, composition and constitution of the forests referred to, and so forth, and he may rest assured that other foresters are quite as anxious as he is to attain true knowledge.

MAURITIUS: 18*th February* 1904. F. GLEADOW.

The Term "Congeners."

The following is perhaps of very small importance, but it is as well to be accurate, and I should like to point out the misuse of the word "congener," which has recenty been misapplied at least on two occasions in *The Indian Forester.*

In my dictionary (Chambers's) "congener" is explained as . . . "of the same kind or nature," and in Mr. Heinig's 'Glossary of Botanic Terms' as "species nearly allied in all essential characters."

In face of these explanations I do not think that it can be correct to refer to *Albizzia amara* and *Santalum album* as "congeners." "Associates" seems to fully convey the intended meaning.

C. FISCHER,
Deputy Conservator of Forests.

A Jest ?

Can any one tell me what is the meaning, if it has any, of the following remark made by Mr. Hauxwell on page 121 of the March number of *The Indian Forester ?*

"We are not yet reduced, as in India, to raising an annual revenue of Rs. 27 on dead teak leaves which has to be collected in instalments."

Is it a jest ?

C. C. HATT,
Deputy Conservator of Forests.

R. S. F. Fagan.

A correspondent in Bombay writes as follows:—"I heard with regret of the death at Brighton on December 21st last of Mr. R. S. F. *Fagan, Conservator of* Forests, Bombay, thus adding another to the sad list of casualties which have occurred recently in the upper ranks of the Forest Department. Mr. Fagan came of an old Indian family and was born in India, whence he went to England at the age of four years old on the outbreak of the Mutiny. His father was killed at the Siege of Delhi. He was trained at Nancy, and came to Bombay to join the Forest Service of that Province in 1877, being appointed shortly afterwards to the Ahmednagar Division. Mr. Fagan served there for a number of years, and was known as a smart and energetic officer. He subsequently held successively the Satara and West Khandesh Divisions, and in both Divisions left behind him a record of good work ably performed. In the latter Division he was also able to indulge in his taste for shikar, and being a good shot, a considerable number of tigers and bears fell to his rifle. On the outbreak of the famine of 1899-1900 he was appointed on Famine Grass Operations on the G.I.P. Railway, S.E. section, with headquarters at Kurjut.

Great difficulties had to be surmounted by him, in common with other Forest Officers on similar work at other sections, in inducing people to bring in grass in sufficient quantities, in keeping the grass presses, which were always getting out of repair, at work, and in getting ties for the grass bales and afterwards railway trucks for the transport of the grass to the famine-stricken centres where it was required. The splendid nature of the work thus quietly and energetically performed by Mr. Fagan and the other Forest Officers was never fully comprehended by Government; and the arduous nature of the work and the exposure entailed by it seriously affected Mr. Fagan's health, which was at no time unfortunately very robust.

"Mr. Fagan's next appointment was to the charge of the North Kanara Division, but he left this Division in about twelve months to take up the duties of Conservator of Forests, N. C., towards the end of 1901. His good administrative abilities here had full scope as serious injury had been done to some of the forests in his circle by the successive years of drought, and energetic measures had to be undertaken to secure the speedy recovery of the forest growth. Unfortunately bad health still troubled him, and led to his transfer to the Southern Circle after eighteen months. This change was at first beneficial, and it was hoped that he would be able to continue for a long period in charge of this circle, in the work of which he took great interest, comprising as it does the management of the best teak forests in the Indian Peninsula. An illness in the latter part of the rains of 1903 culminated, however, in a complete breakdown in the middle of October, and on 31st October he left Bombay on a long period of furlough. Mr. Fagan reached England safely, and the accounts received of his health subsequently were cheering to his friends. Early in January, however, the sad news of his death under distressing circumstances in the previous December was received, and it became thus certain to his friends that his breakdown in health had been even more complete that had been understood at the time he left Bombay. By his untimely death the Bombay Forest Service has suffered the loss of a most capable officer."

The Genus Diospyros in Ceylon.

Mr. Herbert Wright, Superintendent of the Experimental Station, Ceylon, has issued a monograph on *The genus Diospyros in Ceylon—its Morphology, Anatomy and Toxonomy.* The monograph is appearing in two parts, the first of which has alerady been published. Part 2, containing specific descriptions and illustrations, will be issued shortly.

The genus *Diospyros* is the largest and most important of the *Ebenaceæ* and Mr. Wright has been at great pains to deal with his subject from every point of view.

In Part 1 the following arrangement has been adopted :—

I.—History.
II.—Distribution in Ceylon.
III.—Vegetative Characters.
IV.—Anatomy : Timber Properties, etc.
V.—Seedlings.
VI.—Reproductive Organs.
VII.—Affinity.

Under history the whole of the literature on the genus is passed under review, the author commenting on the different views of previous writers on the subject from the time of Linnæus up to the present day.

Under distribution the author divides Ceylon into three zones—dry, wet, and intermediate. Seven species are found in the dry zone, thirteen in the wet zone, and in the intermediate zone, where the rainfall varies from 70 to 80 inches, all the dry zone species except *D. melanoxylon* are found in addition to a couple of the 13 wet-zone species.

The vegetative characters of the various species are fully described and compared, and the anatomy of the various tissues is dealt with at great length. In Ceylon the ebony of export is derived entirely from the genus *Diospyros*, and mostly from the species *D. ebenum*, although *D. melanoxylon* and also *Dalbergia Melanoxylon* both furnish a marketable ebony. The origin of the black heartwood of some members of the genus in discussed, and it is stated that the belief is common among Ceylon foresters that the proportion of heartwood is dependent to a great extent on the nature of the soil. The proportion appears greatest in trees growing on rocky hill sides and decreasing as the quality of the soil improves, analogous in a way to the sandal, in which the proportion of scented wood also decreases with an improvement in the nature of the soil.

The remaining sections are dealt with equally fully and clearly, and on the publication of Part 2, with its descriptions and illustrations, Ceylon will possess in compact form a really valuable monograph on the genus *Diospyros*. It is hoped that the author, Mr. H. Wright, will find time to do the same for other important genera in Ceylon.

"The Indian Field" Shikar Book.

The above is the title of a small book just published by Mr. W. S. Burke, Editor and Proprietor of *The Indian Field*. It has been compiled with a view to enabling the sportsman to obtain without trouble or delay, reliable information about any one of the hundred and one points on which one may want information, either during a sporting trip or when one is making all the inevitable *bandobust* without which in these days no shooting trip can be successful.

All, or at any rate very nearly all, of the information it contains can be found elsewhere, but one's library when out on shikar has to be of the smallest, and in no other book that we know of is there to be found so much general information likely to be useful to the man out on shikar.

It contains a chapter on Big Game in which are given the Latin and vernacular names, habitat, description, habits, average size, record measurements, and other useful details. Similar details are given for small game and birds, while much attention has been given to the river, estuarial and tank sporting fish. The best seasons for fishing and the most likely tackle and bait have not been omitted.

Next will be found a chapter on Camp Equipment, on which the success and pleasure of a shooting trip so greatly depends. The author, however, rightly points out that it is beyond the scope of the book to enter at length into any review of the numerous matters embraced under Camp Equipment, and limits himself to dealing with the main things which are absolutely necessary for comfort and convenience.

To our mind the most useful chapter in the book is the one on Guns, Rifles and Ammunition. Here can be found, at a glance, the charges for most of the ordinary sporting rifles with details of their muzzle energy and striking velocity. Tables are given for reducing drachms to grains, and showing how many cartridges a given quantity of powder will load with grain and drachm loads. The number of pellets per oz of the various sizes of shot forms another table often useful to have at hand. The chapter also contains much other general information, some of which cannot fail to be very commonly useful.

The chapter on Routes to shooting grounds is in our opinion too condensed to be of much practical value, though the lists of dak bungalows may well come in handy during a shooting trip. Another chapter deals briefly with various "shikar wrinkles" in connection with various articles from boots to sandflies, while measures to be taken in case of snake-bite meet with considerable attention.

The Game Laws in force in the different parts of India are usefully introduced, and the book is made complete by game registers for big and small game as well as fish.

The book is wonderfully free from errors, but the vernacular name for the tiger in Southern India is *puli* not *huli*. The kakur in Southern India is called konda gori, *i e.*, jungle sheep, and not jungli bukri. There is no dak bungalow at Dehra, and the list of dak bungalows might be more complete.

The book is tastefully got up, published by Thacker, Spink & Co., and costs only Rs. 5. It should be in every shikar camp in India.

A Visit to Mauritius.

BY F. GLEADOW.

From the sea, Mauritius presents a striking picture of mountain and cliff, plateau and plain, rugged black vertical rocks with their heads often in the clouds, and their feet bathed in the sunny greenery of the sugar cane or the sombre tones of the forest. King of all in majesty, if not quite in height, towers Pieter Both or Booth, a precipitous mass ending in a shapely cone topped by an overhanging ball not unlike (to compare great things with small) a candle extinguisher. The mountain is called after a Dutch admiral who most injudiciously got drowned at its feet when going home on pension. (Still, we do not know what his wife was like—perhaps he was right.) Paul and Virginia surely knew it well; and a happy life they must have led, in days before malaria was introduced. When it arrived, it practically wiped out the coast population, for all who could possibly do so fled to the uplands, and the suburbs of Port Louis, formerly miles of country seats, are now left to the canes, the brambles, and the poor.

Immediately on arrival in harbour I was fetched off the ship by a steam launch specially sent by H. E. Sir Chas. Bruce, and taken to "Le Réduit. I had really come from Karachi and Bombay, but having joined this vessel at Colombo, was techincally free of quarantine, while the unfortunates who had come all the way from Calcutta in her, had to stay all day to be squirted with disinfectants and otherwisely amused by the gentle dalliance of the Sanitary Department. Among other pleasures they could watch the strings of dead horses floating out to sea, for the *surra* had killed most of the animals in the Colony. "Le Réduit" is the Hills Government House (there is another in Port Louis). Its name is derived from the fact that in the century before last it was intended as a refuge for Europeans in case of slave or pirate outbreaks.

In the launch sent for me was the Director of Forests and Gardens, Joseph Vaukeirsbilck, an excellent botanist, a keen forester, and a man justly loved and respected by all. Though in the prime of life and vigour, an inscrutable Providence had already decreed that the casual stranger should outstay him. A few

months later he became ill, got better, was sitting up in a chair talking to me cheerfully one Saturday, and that evening was gone.

One of the first things that struck me was the slackness and absence of discipline in the place: policemen lolling against lampposts smoking cigarettes, railway guards and porters ditto. Neither police nor peons, nor military orderlies in undress think of rising or standing to attention when high officials pass them in public offices Even civilians coming in to business by the morning trains, stroll gently to their offices as though it did not really matter whether they got there before lunch or after. But the worst managed thing I have ever seen is the Prisons Dept. The prisoners are supposed (well, I don't know if I even dare say *supposed*) to work some times. One meets gangs of them in the streets, the leading files swapping good stories with an individual of a very slightly higher type of nobility in front, possibly a warder, and ditto in rear—the whole cavalcade slouching at a pace that made my boots tingle to watch. A military slow march is a gymnastic step requiring some attention, but if you take the slowest approach to it that requires no attention, you have the Mauritius jail-birds' slouch. They do it deliberately, of set purpose, to show how much they care for the Government and the public. What they want is an Egyptian taskmaster behind them, to drive them to work, or mutiny, one or the other, and food or something more drastic accordingly.

The question of prisons naturally leads back to the Press, at any rate it ought to; or rather the Press (in part) ought to conduce, or be conducted, to the prisons. The Mauritius Press proper is everything that it ought to be or can be expected to be in so small a spot. But there is a gutter press which sticks at nothing, except honesty. Being the French type of gutter press, its standing dish is the inherent villainy of the Government and of all its high officers personally. With such a type of press, naturally every Government in France is more contemptible than the last. The French nation appears to like it, but it is a pity that such a press should exist in an English colony, because the surest way to *make* a contemptible Government is to abuse it until no respectable man will take a hand in it. Fortunately here the Government is British, and takes as much notice of the gutter press as it would of a bluebottle buzzing round a dungheap.

Here, in a bit of country forty miles by thirty, which ought to support two morning papers, and at the utmost two evening ones, there must be about twenty, including rags I would not use to clean my gun or my boots with. Like the miserable mangy curs that lie about the Port Louis streets, they must lead a wretched existence, but they don't die: that is the public misfortune. All Port Louis goes home by train every evening, and all Port Louis buys the poison because it wants something to read in the train; and there may be something spicy. If the local sales are

not quite enough to live on, it is always possible to blackmail public men who do not care to spend their time and money shooting carrion.

Society in general is French, and a pleasant and amiable society it is. The English are commercially a minority, and the military are transitory, so that there is not quite as much fusion as is desirable. The resident English element frequents and intermarries with the French freely, but the transitory element is afraid of its linguistic weaknesses, ignorant of its neighbours' virtues, in short insular. There are families with English names whose usual language is French, and familes with French names which always talk English. The language of the unwashed is Creole, an elementary form of French deprived of gender, number and case, but complicated by the addition of incomprehensible negro terms derived from the slaves. Of later years the Indian, mostly from Calcutta or Madras, has pervaded the land; but those who settle here soon forget their classic tongue and take up the barbarous Creole.

The Indian also drops his caste to a great extent (when he has any), and what is worse *she* drops her clothing. I do not mean that she goes about like the ancient goddesses, with a star or crescent in her hair, but that she drops her graceful *sari* and puts on one or more ugly petticoats of Europe pattern. As she also becomes less particular in the ablution of self and clothes she is seldom attractive. Only the plain and moderately plain ones seem to come here. I have seen none of the lovely Aryan bronze or terra (scarcely) cotta maids the very sight of whom is enough to hurl the male reason headlong from its crumbling throne.

The Indian is the future master of Mauritius, and the Mauritians have only themselves to blame. They imported Indians to cultivate the soil, and allowed them to become proprietors thereof. A law forbidding the transfer of agricultural land in lots smaller than 50 or 100 acres would have settled the question.

Far from enacting such a law, certain landowners began by selling to Indians at high prices bits of land that they had no right to sell at all for cultivation, *viz.*, mountain reserves, which the law says are to remain forest for all time.

As the Indian was found to be a greedy buyer of inferior land at high prices in small lots, many estates sold to him all their most barren and inaccessible portions. The Indian for his own hand is a hard and steady worker, and he kept in cultivation for years lands where no Mauritian could exist. In other and more recent cases large areas of good land have been "morcelé," *i.e.*, sold by the acre or half acre to Indians and Creoles. Now half the mills in the island are closed and the crushing concentrated in the remainder, with the result that the Indian who had bought land with a mill within a possible distance now finds himself stranded on an exhausted soil, with double the distance to transport his canes, and not always able to sell them there.

The destruction of animals by *surra* has compelled the large owners to borrow capital and lay down a network of light railways all over their estates, but the Indians have been dragging their laden carts themselves, four to eight men to a cart, working not like "niggers" (for the "nigger" means the African who would rather steal than work any day) but like men. Thus the result so far has been the ruin of many Indian settlers who have abandoned the little fields they had purchased, and reverted to selling their labour. Nevertheless Indian ownership is spreading fast. The next stage will probably be the ownership of the soil by Indian peasants, and the ownership of the mills by Mauritian companies. The Indian will be squeezed, like his canes, until he finds some means of organising in defence. At present he has in some cases two mills competing for his canes, but the concentration of crushing into fewer hands is fast depriving him of this advantage. It is hard on the Indian, but perhaps good for the Colony, which possesses no great margin in the sugar market of the world.

The Creole (by which ambiguous word I here mean the African mixture) sometimes cultivates a small field, but the great body of this class have a horror of agriculture, derived from slave days partly, but also due to the general negro love of play and dislike of work. The Creole, like the British workman, loves to lounge round the drink shop, smoking, gossiping, and spitting all over the place. But he goes further. On his way home at dark he likes to pick up a fowl, a bunch of bananas, or anything else lying around on other people's property. Sometimes he does no work at all, unless it be to beat his wife if she does not work hard enough to keep him in comfort. He is a confirmed poacher, quite ready to shoot a keeper occasionally. He is physically strong and makes a bold coast fisherman given to the use of illegal meshes. As member of a crew he is neither smart nor orderly enough to be of great value. It is laid to his charge that his thievish propensities are responsible for the general absence of garden culture here (even potatoes come from Réunion) and for the almost ruined state of the vanilla industry. He has sometimes an excellent voice and sings with great expression and feeling. Altogether one is inclined to doubt whether the abolition of slavery was not a piece of sentimental hysteria. A "Protector of Slaves" could have put an end to the brutalities that were by no means characteristic of the system, just as effectually as our Protector of Immigrants now sees that the Indians are properly treated, housed, and fed.

(To be continued.)

The Indian Pheasants and their Allies.

By F. Finn, B.A., F.Z.S.

(*Continued from page* 420.)

Chapter IX.

QUAILS.

THE JAPANESE QUAIL.

Coturnix japonica, Blanford, Faun. Brit. Ind., Birds, Vol. IV., p. 116.

Native names:—*Udzura*, Japanese; probably called *Ngon* in Burma.

This species much resembles the common grey quail, but both sexes of it have a richer chestnut tint on the flanks. This of itself would not be much to go by, but the male has the face and throat brick-red, without any trace of the dark markings found there even in the rare reddish throated variety of the common quail; and the female is still more distinct, for although her throat is white like that of the hen of the ordinary quail, the feathers there are long and pointed instead of short and round, and the outer ones have rusty edges. The young males also possess these whiskers at first.

This quail inhabits Eastern Asia, Japan, and China. It comes at times within our limits on its winter migration, and no doubt often gets passed over as a common quail. When Mr. Oates wrote his excellent little work on the game-birds of India, two specimens were in the British Museum from our Empire; both were hens, one coming from Bhutan and the other from Karennee. The latter had been procured by Major Wardlaw Ramsay in 1874. Dr. Blanford, writing on the same subject in the same year (1898) as Mr. Oates, stated that he did not consider these specimens characteristic, and thought it would be better to wait till a male was recorded before including the bird as Indian. Next year, however, Lieutenant H. H. Turner shot another of the species in the Manipur Valley, in February, and submitted it to me for identification with the rest of his Manipur birds. There was no doubt that this bird was a Japanese quail, as the pointed throat feathers were unmistakable, to say nothing of the richly coloured flanks; the specimen is now in the British Museum. Lieutenant Turner states (*Journal Asiatic Society*, 1899, p. 244) that he saw a dozen or so of the birds, which were driven out by the firing of some long grass; thinking they were only common quail, he did not trouble more about them. It would therefore be as well to examine carefully all supposed grey quails shot in Burma. The ordinary species is admittedly rare there, and very possibly this one takes its place. At the same time, intermediate specimens between the two species occur, so that it must be expected that some will turn up which cannot be fairly referred to either.

In its ordinary home this bird has the same habits as the common quail, and its eggs are similar; but the note of the male is different—a great argument for its specific distinctness. According to General Prjevalsky, this note, which alone makes the bird easily distinguishable, consists of "some deep hollow sounds, several times repeated in quick succession."

THE RAIN QUAIL OR BLACK-BREASTED QUAIL.

Coturnix coromandelica, Blanford, Faun. Brit. Ind., Birds, Vol. IV., p. 116.

Native names:—*Chota Batter*, Hind.; *Chanac*, Nepaul; *Kade*, Tamil; *Chinna Yellichi*, Telugu. For the most part, however, this species goes under the same names as the common quail.

This bird is very like the common quail, although a little smaller; but both sexes may be at once distinguished *by the pinion quills being plain drab*, without the pale cross-bars seen in the common species. Independently of this, the male can be distinguished by his brighter and purer colouring below. His throat-marking is pure white and jet-black, and his breast a decided warm buff. with splashes of black, which increase with age till there is a decided black patch in the middle. His bill is also often of a decided black.

This quail is resident or only partially migratory, and is not known outside our Empire. Within this, however, it is very widely distributed, although it has not yet been reported from Kashmir, Tenasserim, or the Shan States; but its resemblance to the common quail no doubt often causes it to be overlooked. It has much the same habits as its larger ally, affecting grass and cultivated ground, and shifts its ground locally according to the rains, whence its name. Thus to Northern Bengal, Oudh, Behar, the North-West Provinces, the Punjab, Sind, and the open parts of Upper Burma it arrives in the monsoon, apparently wishing to escape from unduly damp localities. In many parts of Central and Southern India the bird resides permanently.

It is found in pairs for about half the year, from April to October, and at other times singly. It nests in India from June to October, laying from four to nine eggs in a hollow on the ground, usually unlined. These eggs are a little smaller than those of the common quail, and are much speckled with dark markings; the ground-colour varies from yellowish white to rusty.

I may mention that the species has been recently bred in captivity in England by Mr. Seth-Smith, a Member of the Avicultural Society; this is interesting, as showing that this bird, naturally confined to a warm climate, can nevertheless, like so many such species, bear and propagate in a colder one.

The note of the male Rain Quail is quite different from that of the common quail, consisting of two notes only, like "whit-whit." This difference in the notes of nearly allied birds is very interesting; it is not invariable, for among the ducks, for instance, our Indian resident, the spotted-billed duck (*Anas pœcilorhyncha*) has the

same note as the nearly allied migratory mallard (*A. boschas*), to say nothing of the representative species in Australia (*A. superciliosa*) and South Africa (*A. xanthorhyncha*).

THE BLUE-BREASTED OR PAINTED QUAIL.

Excalfactoria chinensis, Blanford, Faun. Brit. Ind., Birds, Vol. IV., p. 112.

Native names:—*Khair-butai, Kaneli* Nepaulese; *Gobal-butai*, Oudh; *Ngon*, Burmese; *Pandura-watuwa, Wenella-watuwa*, Cingalese. This exquisite little creature is the smallest member of the pheasant family found with us, and both sexes are easily distinguished from our other quails by their very small size and bright yellow legs. Above, both cock and hen are much like the common quail, with a similar intricate mixture of buff, brown, and black; below, they are very different, both from these and from each other. The cock has a slate-blue breast, the colour extending more or less on to the flanks, and a rich chestnut belly; the throat is boldly marked with black and white somewhat as in the Rain Quail. The hen has a buff face, and is buff below with more or less well defined black cross-bars. Cocks have red eyes, and hens and young cocks brown ones. The legs are, as above stated, bright yellow.

This bird is only about six inches long, with a wing of about half that length; it only weighs about two ounces.

Small and fragile though it looks, however, this tiny quail has a wide range in South-Eastern Asia, from India to China and Siam. It also possesses a hardy constitution, for, unlike most birds of its family, it seeks rather than avoids wet ground. Thus it is unknown in the dry regions of North-West India, and common in the moister districts of Bengal and Burma. Indeed, it migrates to some extent in search of damp situations, arriving in Lower Burma in May to be in time for the rains, though in Bengal it is commonest in the cold weather. Its haunts are in rank grass on wet land, and it is often found round paddy-fields. In India and Burma it breeds in June and July, but in Ceylon during the three months previous to these. At these times it is found in pairs, but at other times in coveys. The nest is in the usual hollow in the ground, grass-lined, and contains not more than half-a-dozen eggs, rather bigger than one would expect such a small bird to lay, being about an inch long. They are drab in colour, with more or less of a minute brown speckling. Not much else seems to be known about this little creature in the wild state, but its habits have been carefully studied of late years by certain good observers, members of the Avicultural Society, who have kept and bred it in confinement in England. It turns out to be a most interesting pet, hardy enough to bear our English winters in an outdoor aviary, and a free breeder if growing grass can be provided for it to nest in. The cock is a most attentive husband, calling his hen to take any tit-bit he may obtain, after the gallant fashion of the common fowl. He

occasionally utters a tiny crow, resembling a miniature imitation of the "brain fever-bird's" note. The hen is a prolific layer in captivity, and a good sitter and mother, and the chicks are easy to rear, and the most charming little creatures imaginable; they are literally not larger than the big black bees we are all so familiar with in India, and they can squeeze through half-inch mesh wire-netting! Although they take almost as long to hatch as common fowls, they mature with remarkable rapidity; Mr. Meade-Waldo, who was the first to breed them in England, found that his young cocks, when only just over a month old, had already assumed the proper plumage of their sex, and were actually crowing and calling their little sisters to feed! It is therefore very obvious that, though this minikin quail can hardly be regarded as game, it is pre-eminently suited for a pet; ordinary bird-seed keeps it well, with the addition of a few insects and egg for the young.

Our Forestry Problem.

BY DR. W. SCHLICH, C.I.E.

A year ago the President of the Board of Agriculture appointed a Committee to inquire into and report upon the present position and future prospects of forestry and the planting and management of woodlands in Great Britain, and to consider whether any measures might with advantage be taken, either by the provision of further educational facilities or otherwise, for their promotion and encouragement. Ireland was excluded from the reference in accordance with the expressed wish of the Irish Agricultural Department. One of the Assistant Secretaries to the Department was, however, nominated a member of the Committee, so that the authorities in Ireland might be in full possession of the views of the Committee for further action in that country.

The Committee has now submitted its report, and made various recommendations, which are under the consideration of the President of the Board of Agriculture. In the meantime every serious citizen should be made aware of the problem, and should awake to the necessity of early action being taken in the matter.

The questions which present themselves are chiefly the following:—

(1) Why is the forestry problem of importance to Great Britain and Ireland?

(2) What will be the result, not long hence, if nothing is done?

(3) What is the present state of affairs?

(4) What are the practical objects which the people and Parliament ought to set before them for immediate execution?

IMPORTANCE OF THE FORESTRY PROBLEM.

For the purpose of demonstrating this, it will be necessary to indicate shortly the quantity of timber required by the country. In a paper I read before the Society of Arts on February 27, 1901, I gave detailed information regarding the outlook of the world's timber supply. This information I shall not repeat here, but limit myself to giving a few of the main points. In the first place, it must be stated that although the average forest area per head of population in Europe amounts to two acres, the imports of timber show already an excess over the exports amounting to 2,620,000 tons a year. That deficiency comes chiefly from Canada and the United States of America, and smaller quantities from Australia, India (nearly all teak timber), the countries round the Gulf of Mexico, the west coast of Africa, and a few other places.

It is well known that the supplies from outside Europe at the present rate cannot be relied on beyond a limited number of years, since the United States, as time goes on, will require all the timber which Canada can export, under the system hitherto followed in the lattter country, where reckless cutting and disastrous forest fires are still the order of the day. Russia, with Finland, Sweden, Norway, and Austria-Hungary, which have so far supplied the rest of Europe, will not be able to maintain the exports of the past, owing partly to the gradual exhaustion of their surplus stocks, and partly to their increasing home requirements, due to the growth of their population and the development of industries. On the other hand, the requirements of the chief importing countries (excepting France) are rapidly increasing. The imports of the United Kingdom have grown from 3,400,000 tons in 1864 to 10,000,000 tons in 1899, or at the average rate of 189,000 tons a year. The imports of the latter year were valued at £25,000,000. The average annual value increment of the imports during the years 1890—94 amounted to £382,000 and duringthe period 1895–99 to £771,000. There has been somewhat of a check during the South African war, but signs are already discernible that the imports will resume their gradual rise.

Looking now at Germany, which takes the second place amongst European importing countries, we find that her net imports of timber up to 1864 amounted on an average to 13,000 tons a year. In 1899 they had risen to 4,600,000 tons, or an average annual increase of 131,000 tons. The value of the imports in 1899 came to £14,820,000.

The Belgian net imports of timber amount now to 1,020,000 tons, valued at more than £4,000,000. They have increased during the last thirty-five years on an average at the rate of 22,000 tons a year.

The net imports of France have remained practically stationary during the same period; they amounted to about 1,230,000

tons a year, or little more than the *quantity now imported into* the small kingdom of Belgium.

Of the total area of Great Britain and Ireland, 4 per cent are under forest.

Of the total area of Germany, 26 per cent are under forest.

Of the total area of Belgium, 17 per cent are under forest.

Of the total area of France, 18 per cent are under forest.

Pondering over all these figures, one is almost inclined to say that the requirements of timber are an index to the industrial development of a conutry.

Other European countries which import timber are Denmark, Italy, Spain, Holland, Switzerland (rapidly on the increase), Portugal, Bulgaria, Greece, and Servia; Roumania exports moderate quantities.

The price per ton of timber next demands attention. It fell from 1870 onwards until about the year 1888 in consequence of the enormous development of the means of transport, especially by water. From 1888 to 1894 prices remained stationary, but since then a *slow but steady rise has taken place*, amounting to about 18 per cent during the five years 1894—99. Fluctuations in the price will of course occur, but I have no doubt whatever that on the whole it will continue to rise, in the same degree as supplies have to be brought from localities farther and farther removed from the world's great highway—the ocean. This holds good especially in the case of Russia, the most important source of supply in Europe. Matters have now come to such a pass in that country that the Government has taken measures to ensure a *permanent supply for home* consumption by restricting and regulating cuttings. The head of the Prussian forest department informed me a year ago, that a remarkable change has of late taken place in the western provinces of Russia. German timber merchants, who go there to buy up and work out forests, used to send all the timber to Germany; now they transport already considerable quantities into the interior of Russia, because there they obtain better prices than in Germany. To sum up, it may be said that the *quantity of timber* required in Europe is rapidly increasing, so that the deficiency in the supply must advance correspondingly, making it more and more problematic whence the material, especially the coniferous timber, is to come in the future.

EFFECTS OF A SHORTAGE IN THE TIMBER SUPPLY ON THE UNITED KINGDOM.

It is all very well to say that we can pay for the timber we need, but that will not meet the case. When the supplies from outside fall off, the rise in prices may become prohibitive, and *the effects of an insufficiency* of material would be disastrous. Of the 10,000,000 tons a year imported lately into this country, 8,700,000 tons were coniferous timbers, which form the very staff of life of our building trade and mining operations. A

deficiency of supply in this material would be a real calamity for the population of these islands. Let us not deceive ourselves by imagining that in such an emergency iron and steel can be substituted for timber. That this is a fallacy has been proved by past experience. While the population of the United Kingdom has increased by about 20 per cent during the last twenty years, the imports of timber have increased during the same period by about 45 per cent; in other words, every inhabitant uses now considerably more timber than twenty years ago. At the same time, nobody can say that extraordinary efforts have not been made of late years to substitute iron and steel for timber. As a matter of fact, the latter is an absolute necessity to civilised peoples. Engineers have not even succeeded in superseding the wooden railway sleepers by steel sleepers. Mr. Hawkshaw, in his presidential address to the Institute of Civil Engineers the other day, dwelt particularly on this subject, saying: "Engineers could not do without timber, nor, indeed, without much timber. For the last thirty years they had heard it said in that room that steel would shortly be adopted in place of wood for sleepers; but although we could make our own steel, but had to import our timber sleepers, this has not come to pass," etc. The same experience has been gained in France and in the United States of America, the home of the great iron and steel Trusts. As to the effect of a shortage of the timber supply on the mining industry, it would be too terrible to contemplate, as it would practically bring mining to a standstill, and throw hundreds of thousands of workmen out of employment, and the same may be said of the building trade.

The Present State of Affairs in this Country.

The United Kingdom of Great Britain and Ireland has an area of 78,000,000 acres (in round figures), of which about 3,000,000 acres are classed as under wood, equal to not quite 4 per cent of the area. This makes about $\frac{1}{14}$ of an acre of woodland per head of population—an area capable of yielding only a fraction of the timber required by the nation. Hence we find that the imports amount to at least five times the amount produced in the country. An examination of the agricultural returns of Great Britain and of those of Ireland show that there are extensive areas of waste land which yield either no return or a very small one. Again, there are other areas entered as mountain land used as rough grazing. These lands may be apportioned as follows:—

	Waste land, including inland water.	Mountain and heath land.	Total area in acres.
England	4,050,000	1,985,000	6,035,000
Wales	690,000	1,055,000	1,745,000
Scotland	4,250,000	9,410,000	13,660,000
Isle of Man and Channel Islands ...	45,000	18,000	63,000
Ireland	5,235,000	...	5,235,000
Total	14,270,000	12,468,000	26,738,000

I am not in a position at this moment to say what the area of inland water may amount to, but for argument's sake let us assume that there are of

Actual waste land ...	...	...	...	12,000,000 acres.
Mountain and heath land	...	...	...	12,000,000 "
Or a total of ...	...	...	...	24,000,000 "

This area is extensive enough to set people considering whether that land could not be used in a more profitable manner than at present. The question is, however, not so simple as it would appear at first sight, because nearly the whole of this land is private property, and most of it is utilised as shooting-grounds. The latter, however, after all is said, do not, even in Scotland, yield more than 1s. 6*d*. an acre all round, while the rest give much smaller returns, down to perhaps 3*d*. an acre, and in many cases not even that.

How to Obtain a Permanent Supply of Timber in this Country.

It is obvious that this country cannot interfere in the management of the woodlands of foreign countries. Again, under the enlightened principle followed by Britain, that her great colonies shall be self-governing, any interference with their internal management is out of the question. Amongst the latter, Canada and Australia take the chief places as regards the supply of timber. Although forest conservancy in Australia is anything but enlightened, we can count for a good many years to come on a considerable quantity of hard woods. These, however, will only serve for certain limited purposes, while 87 per cent of our imports are coniferous timbers, the supply of which requires our chief attention. Canada could furnish them, if the Governments of that country would put their shoulders to the wheel. Without going into details, I may say that the lumber and milling interests of Canada are so powerful, that it seems almost hopeless to expect a decided change of policy in the management of her forests. In the meantime the resources of the latter are rapidly decreasing.

Under these circumstances, let us consider what can be done at home. With the exception of about 67,000 acres of Crown forest, all British woodlands are in the hands of private proprietors, or one or two municipalities. Most of the woodlands are maintained for landscape beauty, shooting purposes or shelter, so that their yield cannot be considerably increased. Again, the 24,000,000 acres of land, of which I spoke above, are private property. Of that area a large portion is fit for afforestation, and the question arises whether this can be achieved, and if so, in what manner?

In a paper read before the Society of Arts in November 1899 it was boldly proposed that Parliament should allot £1,000,000 a

year during the next hundred years, so as to acquire and afforest 6,000,000 acres of land, which would yield all the ordinary timber required in the United Kingdom. It was argued that only the State was in a position to do justice to the scheme for any length of time, as has been done in other European countries. The position of Britain is, in this respect, somewhat different from that of other continental States. In the latter, the areas now forming the State forests were, with small exceptions, always State or Crown property, and it required only the gradual introduction of systematic and scientific management to render them highly remunerative. In Great Britain the lands are, as already stated, private property, and it would not be easy in England, or even in Scotland, to acquire large areas, because owners would not care to sell. In Ireland the difficulties would probably be much smaller. To expect Parliament to vote £1,000,000 a year, and for a hundred years, is, of course, Utopian, but I fail to see why the State should not do something on a smaller scale. A more modest sum might be set aside for the purpose, and either the Commissioners of Woods, or the Agricultural Department, or both, instructed to acquire any suitable surplus lands whenever opportunities offer. In this way the area of the State (or Crown) forests might gradually be increased in England, Wales, and Scotland.

In Ireland operations on a somewhat larger scale might be attempted. A new Irish Land Bill is about to be laid before Parliament, and provision might be made in it for the acquisition by the State of all waste lands which it is not necessary to include in the farms to be acquired by the tenants. In this way a considerable area might be obtained at a very low price. It has been estimated that of the 5,235,000 acres of waste lands in Ireland, not less than 3,000,000 are fit for afforestation. Most of these lands can be bought for from ten shillings to one pound an acre. Assuming that only half the area so bought is really fit for successful afforestation, the purchase price per acre of real forest land would be between one and two pounds per acre. At that rate the financial success of afforestation would be ensured. In Ireland, then, the State can, and in my opinion should, interfere by the direct acquisition of State forests. Such a measure would be a great help in the settlement of the Irish land question. The labour connected with the preparation and planting of the land, the subsequent management and working of the forests, and the development of industries which draw their raw materials from the forests, would provide just that class of additional work for the small Irish farmer, especially in the poorer districts, which will assist him in earning the necessary money to pay off the instalments which will gradually convert him into the proprietor of his farm.

In England, Wales, and Scotland the acquisition of State forests will probably be a very slow process. Here we must work

in a somewhat different way. We must count on extended afforestation by the landed proprietors, but the State should do what it can to help. The chief desideratum is to provide the means of acquiring a sound knowledge of systematic forestry as elaborated by scientific and practical investigation. First and foremost, the sons of the big landowners and young men who are preparing for the highest class of estate managers, must be given the opportunity of acquiring such knowledge. Hence the establishment of a course of forestry teaching should be arranged at Oxford, Cambridge, Edinburgh, and Dublin. Ultimately regular forest faculties may be organised at these Universities, or a joint faculty for forestry and agriculture, but at the outset we may be satisfied with the appointment of a lecturer on forestry at each of these centres of learning.

For practical instruction an area of 100 to 200 acres should be acquired at or near each university, where sowing and planting, etc., could be taught, and where illustrative experiments could be made. But something more is wanted; and this has been fully explained in the Forestry Committee's report. There should be at least one larger area in each, England, Scotland, and Ireland, of from 2,000 to 10,000 acres, under a competent manager, where systematic economic forestry is carried out on a large scale. These State demonstration forests will serve a double purpose: they will afford the means of introducing university students to systematic and rational management, such as is likely to be adopted on the estates with which they will afterwards be connected. These areas must be managed as commercial undertakings, so as to produce the best financial results. In the second place, young men of the working classes can be received at these forests as working apprentices, giving them an opportunity of acquiring a sound knowledge of the business, thus fitting them for the posts of woodman, forester, or bailiff on the various estates of the country. Finally, arrangements may be made at agricultural colleges for instruction in forestry for the benefit of men who, while unable to pass through a university course, prepare for the management of landed estates.

As to the funds required for extended afforestation, these will no doubt be forthcoming in the case of many landed proprietors as soon as we have succeeded in convincing them that economically conducted forestry will pay a fair interest on the invested capital. In other cases, however, this will not be so. The Forestry Committee in their report have dealt with the question of State loans at low interest, and suggested that the matter might stand over for the present. I should, however, like to draw attention to the system of Co-operative Credit Organisations, upon which Mr. Montgomery published, in 1902, an interesting bulletin. Such Credit Organisations should be local, where members can obtain advances at a moderate rate of interest, either for a short

period or on the principle of a sinking-fund. Organisations of this class have, I understand, already been started in Ireland and elsewhere, but a further and considerable extension would doubtless prove of the greatest assistance to landed proprietors.

The financial aspect of the problem is, of course, of the highest importance, but at the same time it is most difficult to deal with, owing to the absence of suitable data. The Forestry Committee have taken a considerable amount of evidence on the point, and arrived at the conclusion that excellent results, even with indifferent management, have often been obtained from plantations formed on land of little or no value for any other purpose. Nobody expects that waste lands, which have for a long period of time been exposed to deteriorating influences, will at once spring into full production on being planted, and this is specially pointed out in the evidence; but there can be no doubt that most of our waste lands were once under forests, and, if the thing is done in the right way, can again be successfully afforested in spite of initial difficulties.

In order to show how proper management will lead to increasing financial prosperity, I propose placing before the readers of the *World's Work* a few data from the history of the Saxon State Forest. Saxony is a highly industrial country, and in this respect comparable with Great Britain. We have reliable statistical data about these forests since the year 1817, from which it appears that the area in 1817 amounted to 367,499 acres and in 1893 to 428,542 acres, giving an increase of 61,043 acres, equal to 17 per cent. These lands include good, bad, and indifferent soils, and the greater part are situated in mountainous districts up to an elevation of nearly 3,000 feet above sea-level. The yield in wood per acre amounted in 1817 to 61 cubic feet; in 1893 it had risen to 92 cubic feet, or an increase of 31 cubic feet, equal to 50 per cent. We do not know what the average stock of wood standing on each acre was in 1817, but in 1844 it came to 2,173 cubic feet; in 1893 it had risen to 2,658 cubic feet, representing an increase in fifty years of 505 cubic feet, equal to 23 per cent. This shows that, in spite of the greatly increased yield, the forests are now much more valuable than fifty years ago. The net returns (after deducting *all* expenses) show the following results *per acre and year*:—

During the period	1817–26	... ... 4·0	shillings.
" "	1827–36	... ... 4·2	"
" "	1837–46	... ... 4·7	"
" "	1847–53	... ... 6·5	"
" "	1854–63	... ... 10·0	"
" "	1864–73	... ... 14·8	"
" "	1874–83	... ... 17·5	"
" "	1884–93	... ... 18·4	"
They rose further in 1900 to		... ... 22·5	"

I may add that the average receipts per cubic foot of wood were 2·1*d.* in 1817 and 4·5*d.* in 1900, a rise equal to 114 per

cent., while the above figures show that the net receipts per acre have during the same period risen by 462 per cent.

Surely here is an incontrovertible proof of what scientific and systematic management of woodlands can achieve!

There are many other important points connected with this subject which I should have liked to discuss, but want of space prevents my doing so. Enough has, I hope, been said to demonstrate the extreme importance of the problem, and the simple steps imperatively called for to solve it.—*World's Work.*

The Timber Trade of Manchuria.

In view of the great interest just now taken in all matters concerning the Far East, the account of the operations of Russia to capture the timber industry in that district will be welcome. The following particulars were supplied to *The Columbia River and Oregon Timberman*, by Mr. H. B. Miller, the United States Consul at New Chwang:—

There are many lumbering enterprises being established in Manchuria, Siberia, and Saghalin, preparing to compete with the Pacific Coast lumber.

The most important is the Russian Timber and Mining Company, of the Far East, with headquarters at Port Arthur. This company is organised by some of the most prominent men connected with the Russian Government, and has a very large capital of 20,000,000 roubles, so it is reported.

Their principal operations will be on the Yalu River, where they run down timber from the forests of Corea as well as the large forests of Manchuria. I have been informed by men who have seen these forests that they are very extensive, and contain immense quantities of exceedingly fine timber. There is much fine timber in this market from that locality, and it has been the source of supply for both this and the Tien Tsin market for ages.

The ocean and river junks are built of this timber, hewn out in large pieces—often three feet and more in width. There are about 25,000 of those junks trading in this port. The timber is mostly pine, very much like the white pine of our country. This is the best quality of lumber that I have seen in China. The per cent of clear is not very heavy.

There is also considerable fir, usually much smaller than the pine, and also a timber similar to our tamarack. These are the three varieties that I have seen from the Yalu district. It is brought into this market and the other markets of China on junks. These junks when coming to this market usually sail in fleets as a means of protection against pirates, who often board them near the mouth of this river and rob them or levy tribute on them.

Most of this timber is driven or rafted down the Yalu in short lengths, and it is almost impossible to get long timbers

from this district. The Chinese in their native affairs seldom use any but short timbers, and all the timber cut for Chinese consumption is cut into short lengths in the forests.

Up to the present time all these logs from this section have been cut into lumber by the whipsaw method of the natives, using a thin and narrow saw blade with teeth set so as to cut both ways of the saw's motion. Where the Russians have charge of this native saw mill they have introduced the large and heavy saws, cutting only on the downward stroke, such saws as are used in our country for whipsawing lumber, and with these the natives accomplish much more.

On the Yalu this old method is now to give way, and Russia is to construct there at the mouth of this river the third largest saw mill in the world. I have not been able to get the details or to ascertain whether the mill is to come from America or not; but it is certain that a great mill enterprise is already in process of construction.

This is at the point of political controversy and the most likely place of conflict between Russia and Japan. It is at the place of the great naval battle between China and Japan, the conclusion of which practically settled the fate of that war.

The establishment of this enterprise is very likely to influence the lumber trade of China to some extent, but more particularly in Manchuria and North China. I am inclined to the opinion that it will not seriously affect the trade in Central China.

In addition to this competition, which is already supplying large quantities of timber and lumber at Port Arthur, Dalny and New Chwang, and for the Chinese Eastern Railway, the Russians are now shipping to all of these places by steamer from Vladivostock and vicinity and the Island of Saghalin large quantities of lumber.

This lumber from that section, so far as I have seen, is of a rather inferior quality compared with the Yalu lumber, is harder, coarser grained, warps and twists badly and is difficult to work. Compared with the Yalu timber, it is about like the Norway pine as compared with the white pine. It is in fact very much like the poor grade of Norway pine. What I have seen may not be the best quality, however. I am informed that the forests of Siberia and Saghalin Island are quite extensive, and that the lumber production in that section is susceptible of great development.

This information I have from very reliable sources, but I cannot write of it from personal observation. Mr. Clarkson, formerly of Portland, Oregon, has a saw mill and sash and door factory at or near Vladivostock, and is reported to be having much success in this and other enterprises.

Another point of Russian competition in the lumber business is developing on the River Sungari, where the Chinese Eastern Railway crosses it, about 80 miles south of Harbin. Timber in

considerable quantities is run down this river to this point, and is being made into lumber by the Chinese method, several hundred men being engaged in the work. I am of the opinion that lumber from this source will never reach the sea in competition for the trade of China ; but it will be a splendid source of supply for railway use and for the city of Harbin.

This timber, so far as I have been able to see, is a fair grade of white pine, but the logs are all small. Whether this is due to the difficulties of driving on the stream or to the small growth in the forests I have not been able to learn.

Harbin is to-day only three years of age, but is one of the greatest cities of Asia, and contains the largest European population of any Asiatic city, containing 60,000 Russians besides the soldiers. At Harbin there are two small saw mills cutting timber from the River Sungari, coming from below the city. On the railway line between Harbin and Vladivostock there are two large saw mills, the machinery for which cost in place 150,000 roubles. These mills are engaged in cutting lumber at present for the railway and for the town of Harbin.

It is clear that Russia intends to provide for all the requirements of lumber in Manchuria and Siberia with a possibility of entering the Chinese market.

The Government has established a ruling that all railway and Government supplies must be purchased from Russian companies if possible, and this is encouraging many industries in Manchuria, and the lumber industry is one of them.

The recent purchase of considerable quantities of lumber from the United States was due to the haste in providing quarters for troops necessary to take care of the large army she has in Manchuria, and to hurry to completion many buildings and structures required to carry out her occupation. The railway will require many ties or sleepers, as they are decaying very fast, and many have to be replaced even before the railroad is completed.

This is due to the fact that the railway is not yet ballasted, and the ties are laid deep in the earth and sand, not even the ends being exposed to the air. These ties are now coming in considerable quantities from Siberia and Japan, and I do not believe it possible for our country to compete for the trade.

FORESTRY IN THE HAWAIIAN ISLANDS.—*The Hawaiian Planter's Monthly* publishes the report of the Committee on Forestry which was lately formed to devise some practical method of establishing forestry reservation in the Hawaiian Islands. The method devised would appear to be original. The Committee recommended the Governor to appoint some person in each district who should take upon himself the responsibility of making a map and description of a proposed forest reservation in such district, to be submitted

to the Governor for approval. If the proposals were accepted, the persons appointed in each district were to secure subscriptions to secure the fencing of the reservations. The Committee also recommended to the Governor the names of certain persons who were to take up those apparently uncontrolled and unrewarded duties. A bill was subsequently passed for the constitution of a Board of Forestry and Agriculture, to consist of five members. The Board has subsequently been organised and placed itself in communication with the Bureau of Forestry at Washington. The Bureau with characteristic energy forthwith deputed an officer to Honolulu to inspect, and as a result of his inspection and report, the Bureau has at the request of the Governor of the Hawaiian Islands, recommended the appointment of Mr. Hosmer, one of its own officials, to be Superintendent of Forestry in Hawaii. He will work under the Committee on Forestry, which has appointed several gentlemen as unpaid Forestry Agents in their respective districts.

FORESTRY INSTRUCTION AT THE FOREST OF DEAN.—With a view to giving effect to the recommendation contained in paragraph 25 of the Report of the recent Department Committee on British Forestry, the Commissioner of Woods, in charge of Dean Forest, and the Highmeadow woods adjoining, has arranged, with the sanction of the Treasury, to start an experimental course of intruction for student woodmen who will be employed in these Crown woods during the time of their training. Mr. C. O. Hanson, of the Indian Forest Service, has been appointed Instructor, under the supervision of Mr. Philip Baylis, the Deputy Surveyor of Dean Forest. The classes will be held in the Crown Office, Coleford, and will begin about the middle of January 1904. The course will be spread over two years, and will include instruction in Forestry, Botany, Sylviculture, Forest Mensuration, and Protection of woods. Eight young men have applied to become students, six from the Forest of Dean, where they are already employed, and two from Windsor. This is as many as employment can be found for at present. It is hoped that next year, when the first eight will have completed the first part of the course, and will go on to the second part, that eight more may be taken on to take up the first part in succession. At the end of the first two years, and every year afterwards, an examination will be held, and those student woodmen who pass satisfactorily will receive a certificate, signed by the Commissioner of Woods and the Deputy Surveyor of Dean Forest.

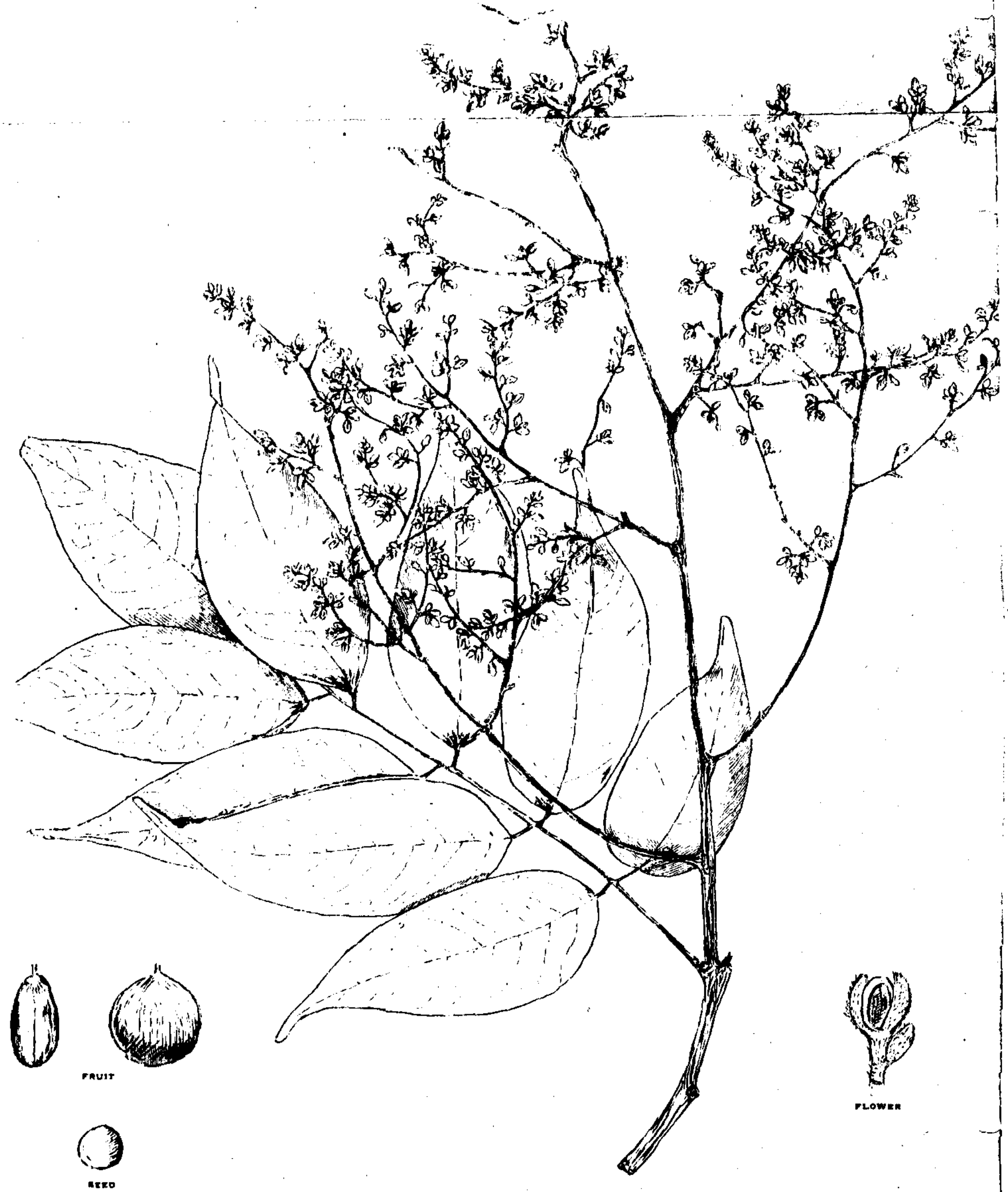
RE-AFFORESTATION IN ITALY.—Mr. Neville-Rolfe, British Consul in Naples, refers in his latest report on his district to the widespread interest now being taken in Italy in the ques-

tion of re-afforesting the country. In 1877 about four millions of acres were withdrawn from the operation of the old forest laws, as well as about one million acres in Sicily and Sardinia. The consequence was a reckless destruction of forests; and now it is generally admitted that the State must step in to save those that are left and to aid in replanting. The question now being discussed is, What trees are to be used for the latter purpose? The Italian oak is of little use except for railway sleepers; there is plenty of chestnut all over the country, and pine trees would grow luxuriantly and prove most useful. The cork tree, however, appears to be the one which would prove economically the most valuable, and it has hitherto been almost wholly neglected in Italy. In 1900 the cork exported was valued at only £36,000, and much, no doubt, was used at home. But a few years ago, Spain exported wine corks to the value of over a million sterling. In Italy about 80,000 hectares of land are under the cork tree, chiefly in Sicily and Sardinia; in Portugal, Spain and Algeria the areas respectively are 300,000, 250,000, and 281,000 hectares. The Calabrian cork forests have been almost wholly destroyed, the trees having been burnt for charcoal, and even Sicily now imports cork wood in considerable quantities. Seventy years ago nearly all the cork imported into England came from Italy; but since then most of the Italian forests have been destroyed for charcoal, and to produce potash, and those that remain are being devastated for the same purposes; and no one thinks of replanting the ground, which naturally gets washed away owing to the absence of trees. Large forests *containing a majority of cork trees* are continually being released from the forest laws, and there is a risk that the production of cork in Italy will soon cease. Nothing can replace cork in its manifold use, and now, when vast quantities are used in making linoleum and in shipbuilding, an adequate supply of it is of great economical importance.—*The Times*, April 21st, 1901.

Mr. E. Jackson, the Port Engineer of Karachi, has carried out some interesting experiments regarding the comparative value of sleepers of jarrah wood, deodar and babul wood. It has been found that exposure to the sun's rays cracks the jarrah wood more quickly than it does the deodar. Sleepers placed for three years under water of both jarrah and deodar are found to have been practically unaffected, but the jarrah wood was a little brighter in appearance; the babul was, however, almost destroyed by marine insects. The experiments go to show that as regards durability there is little to choose between jarrah wood and deodar, but the deodar is considerably cheaper, costing Rs. 4, while the jarrah costs Rs. 4-6 a sleeper. The deodar has also the advantage of being lighter in weight, and thus is less costly in transport and in laying down. While deodar sleepers can

be easily moved or carried by a couple of coolies, it takes four to move one of jarrah wood.

TEACHING OF FORESTRY IN THE PROVINCES.—The Technical Educational Committee of the Fife County Council have issued a circular intimating that they have made an arrangement with the Edinburgh and East of Scotland College of Agriculture under which Mr. Fraser Story, who studied Forestry at Edinburgh University and at Eberswalde Forest Academy, will conduct a course of nine lectures and two out-door excursions at Kirkcaldy and Cupar during the months of December, January, and February. In the circular the Committee say: "It is the intention of the Committee in these lectures to provide systematic scientific instruction of such a kind as to be readily adapted to local circumstances. As far as possible the class lessons will be of a practical kind, and further provision will be made by which the students will see for themselves the best methods to be carried out in daily practice."



DIALIUM TRAVANCORICUM, BOURDILLON

M. M. Bourdillon delt   A. P. CORTEZ & CO. LITH. BOMB.

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Dialium travancoricum.

A NEW SPECIES COMMUNICATED BY J. F. BOURDILLON, F. L. S.

LEGUMINOSÆ.

Dialium travancoricum—Sp. Nova. Mal. "Malam puli." Leaves imparipinnate, rachis 5 in., slender, leaflets 7—11, sub-opposite or alternate, shortly stalked, thinly coriaceous, glabrous, ovate, candate-acuminate rounded at the base and dark green, each 2—3 in. by ¾—1¼ in. Flowers small, numerous in lax, terminal and axillary fulvous-pubescent panicles, each ⅛ in. long. Sepals 5, much imbricated, brown and very pubescent. Petals o. Stamens 2, erect, with large, subsessile anthers. Ovary oblique, very hairy, with 2 ovules. Legume spherical, but laterally much compressed, ⅞ in. across and ½ in. thick, dark velvetty brown, containing one pale brown seed.

A magnificent evergreen tree occurring in the forests of South Travancore near Ponmudi between 1,000 and 2,000 ft. and very local. Height 100 ft. Diameter 3 ft. Flowers July—September. Fruit ripens May-June. Bark pale brown, smooth, ⅛ in. thick. Wood brownish-grey, marked by lines of darker colour, hard, smooth and close grained. Centre darker, but no heart. Pores rather scanty, large and evenly distributed. Medullary rays very fine and conspicuous, crossed by numerous concentric lines of paler tissue, giving the wood a mottled appearance. Annual rings marked by darker lines about 10 to inch.

Weight = 57lbs. P=894.

The fruit is called by the hillmen the "hill tamarind." The endocarp is bright red and spongy in texture and is slightly acid. It is greedily eaten by birds of all kinds when the tree is in fruit. The wood is strong and useful, but is not at all used. The tree is well worth cultivating for its very ornamental appearance.

I first noticed this tree many years ago, and for a long time assumed that it was the Ceylon *D. ovvideum*, but a comparison of the flowers, fruit, and timber with the description of them given in Trimen's *Flora of Ceylon* showed that the two were distinct, an opinion subsequently confirmed by an examination of the timber of the Ceylon tree at Peradeniya, and of its flowers at Kew. The chief points of difference are that (1) the leaflets are more numerous and broader than in *D. ovvideum*. (2) The flowers are nearly globose on stout short pedicels and are covered

with tomentum in *travancoricum*, while in *ovvideum* the flowers are long and pointed, on long slender stalks and are glabrous. (3) The anthers of *travancoricum* are subsessile, but in *ovvideum* filaments are as long as the anthers. (4) The fruit is round and compressed in *travancoricum* with a bright red endocarp, but in *ovvideum* the fruit is ovvid and the endocarp is buff coloured.

When the late Mr. Lawson, Government Botanist, visited Travancore at the end of 1893 I pointed out this tree to him, and we picked up some of the fruit, which was sent to Calcutta. A reference to it appeared in the *Journal of the Asiatic Society of Bengal*, lxvi, ii, 483, while in Gamble's *Manual of Indian Timbers*, page 276, our tree is provisionally named *D. coromandelianum* Hontt. By the courtesy of Major Prain, I.M.S., I have been able to obtain a copy of the description of the above named tree, published by Honttuyn in 1773 at Amsterdam, and also a copy of his illustration of it. From these it is evident that Honttuyn's tree was not the same as ours, and this is not surprising, seeing that *D. travancoricum* is a very local tree, being confined, as far as is known at present, to a very limited area, and is not likely to occur on the Coromandel coast. Honttuyn describes the flowers of his tree as being yellow with green stamens, and of the latter the illustration shows 5, and not 2. The leaflets are said by him to number 4 or 5, and to have white veins, which the illustration clearly shows, and neither of these characters fits our Travancore tree (*cf. Brandis Indian Trees*, p. 251).

The illustration shows—

1. Flower with 2 sepals removed showing the large subsessile anthers, all × 6.
2. Fruit natural size.
3. Seed natural size.

J. F. BOURDILLON.

QUILON, 26*th March* 1904.

The Afforestation of Great Britain.

In the debate on the address in the House of Commons in February last, Mr. Keir Hardie moved an amendment in which he expressed regret that the Government had not seen fit to recommend the creation of a department of labour empowered to deal effectively, in conjunction with local authorities, with the problem of the unemployed by the execution of public works, afforestation, and the encouragement of agricultural pursuits.

The following is the *Times** summary of the answer given by the Minister for Agriculture:—

Mr. Long expressed his great sympathy with the deserving unemployed, a sympathy which was shared by every member of the House. It was only, he pointed out,

* The London *Times* for Saturday, February 20th, 1904.

when they came to the consideration of the remedies that should be applied, that differences of opinion disclosed themselves. The Government did not believe that there was any necessity for the establishment of a labour department. It had been suggested that as an alternative the Local Government Board should be strengthened; but even if that were done, the difficulty of providing for the unemployed would continue. Some members desired that the obligation of finding work for the unemployed in London should be thrown on the metropoliton area as a whole; and to them he was bound to point out that his department was in the position of trustees for the ratepayers, and that so serious a change ought not to be effected without most careful consideration. He failed to see how a labour department could do more than could be done by the Local Government Board and the Board of Trade. The idea that a special department could make arrangements for setting up Imperial works, country works, and local works was not practical. As to afforestation on a vast scale, which was the second remedy advocated, he must point out that nothing of the kind had ever yet been undertaken by the State. It had always been the custom in this country to leave remunerative works to private enterprise. But even if a great scheme of afforestation were started, the majority of the unemployed would not be benefited, for, having no experience of work upon the land, they could hardly be set to digging, draining, and planting. As to the men who were willing and able to do ordinary agricultural work, they would find very little difficulty in obtaining employment, if they looked for it.

When the Minister for Agriculture can get on to his feet in the House and answer a practical proposal, apparently to the satisfaction of the majority of members, in the above fashion, progress in the afforestation of Great Britain would appear to have gone a long step backward as far as the English Ministry are concerned, since the lamented death of that far-seeing Minister Mr. Hanbury. Mr. Long's expressed sympathy with the unemployed would not appear to go very deep since almost in the next breath he makes them out to be absolute incapables. We read that he is of opinion that they, through inexperience, could not be set to digging and draining and planting work. How much experience is required to dig a hole a foot square on a barren moor or to trench and drain such an area. Mr. Long can scarcely mean that the unemployed of London and other great cities are unable to handle a spade or do not know what the implement looks like. Thousands are employed clearing the streets after a snowstorm in London, and L.C.C. notices all over the town at the present moment state that the men are to bring their spades with them if they wish employment. We admit that the planting does require some experience, but only such as an average man, and more especially the average Londoner, who, if nothing else, is quick and

smart enough when he likes, would quickly pick up. But to any one who pretends to have the slightest acquaintance with agricultural matters, we will not say forestry matters, the spectacle of a British Minister solemnly telling members in the House of Commons that trenching and pit digging would be quite beyond the powers of the unemployed, and *per contra* that afforestation is quite out of the range of pratical feasibility in Britain, would be ludicrous in the extreme were it not for the much-to-be-deplored ignorance and conservatism it gives evidence of. But it would not have been difficult to expose this ignorance, and it seems a pity that it did not occur to Mr. Keir Hardie to ask Mr. Long how it happens that Londoners have proved themselves so apt as hop pickers. That garden of England, the county of Kent, is as full of hop pickers as a porcupine of quills in September, and the twang which is the most familiarly heard on all sides is the dreadful Cockney one. Most owners of hop gardens will tell you that although the Londoner requires to be looked after pretty smartly, for he is not averse to lifting anything and everything he can lay hands upon, yet in the field at his work he will do as much again as the country labourer in half the time. In the same manner that the Londoner has learnt to become an adept in the hop field in the autumn, so would he and the unemployed in many other great towns quickly learn the rougher part of the woodcraft he could be put to through the long winter months were the British Government to follow the lead of every other State of importance in the world, and commence planting up its waste lands.

But Mr. Long's answer goes deeper, and therefore is more serious, than Mr. Keir Hardie's question necessitated. I would draw attention to the words "As to afforestation on a vast scale, which was the second remedy advocated, he must point out that nothing of the kind had ever yet been undertaken by the State. It had always been the custom in this country to leave remunerative works to private enterprise."

These words put the Minister's attitude in a nutshell. In the past our Islands were covered with thick forest. As the population grew more intense, this was hacked down until not a bit of timber worthy of the name was left in the country. Our supremacy at sea and our vast coal-fields have enabled us to do without these absent forests up to the present time. We have our coal for fuel purposes, and we are rich enough, and apparently content enough, to pay a large price for imported timber much of which could be grown at home at less cost, whilst at the same time furnishing work for a large number of our unemployed. This is the present position, and the Minister for Agriculture does not see why we should depart from it, because forsooth "nothing of the kind had ever yet been undertaken in the State." Every forester, and many others who have

cared to take the trouble to study the question, knows that the day must come, and is much nearer than is dreamt of in our Islands, when the question of the afforestation of some part of them will be one of the very first importance. It will then be found that with all our wealth this is one of the few things that a vote in Parliament for the necessary money will not be able to remedy. Such a vote can now place battleships on the sea, encircle the country with heavy forts and giant guns, build docks and raise regiments in a comparatively short space of time, but the then Minister of Agriculture will find that it will be quite impossible to create forests which will be able to give any yield in timber that he or the majority of the House who agree with him will ever see.

And this brings us to the fallacy in the second portion of the above-quoted extract —"It had always been the custom in this country to leave remunerative works to private enterprise." Has Mr. Long ever heard of a country called India, and is he acquainted with the general lines of Government policy in that vast country? The above words have a very familiar sound. They are to be found in many an Indian official document and reply, for this is also the policy of the Indian Government. But it stopped short at Forestry. It is a good many years ago now since forest conservancy was introduced into the country. It is said, and it has been proved times without number, that every good move, every new departure, for the amelioration or the safeguarding of the interests of the human race is ever met by the strongest opposition, has to cope with ignorance and conservatism, or, to call it by its proper term, crass obstinacy on the part of the race in general and of some of its strongest men in particular. The introduction of Forestry in India was no exception to the general rule, and that the policy triumphed over all opposition, that the work was carried on often under the most trying conditions both mental and physical to its advocates until the present great department arose into being but shows the absolute necessity that existed for such, and the justness, the clearheadedness and longsightedness of those responsible for its inception. It was realized, and realized once and for all, perhaps hastened by the fact that there is not in India that large amount of capital always ready for investment to be found in England, that the formation and maintenance of the forests was not, could not, be left to the private person, to the capitalist, the company promoter, *et hoc genus omne*, for the very good reason that from the very nature of such property early returns from large areas were not a possibility. When capital has to be locked up for a number of years, when neither the capitalist nor his son nor the company promoter, nor his shareholders will in all probability ever see any return in cash for their outlay, one can scarcely, Mr. Long knows well that one cannot, expect or hope that great financiers will lay out their money in this fashion. To leave the afforestation of the British Isles to private enterprise is

tantamount to saying that the benefits of such afforestation are not believed in by the present Ministry, that last year's great talk upon the subject was quibbling and moonshine, and that the problem of the unemployed, for that it could to a large extent be solved in this way, and perhaps only in this way, few who have studied the matter doubt, is still to remain unsolved and neglected. We would like to see the House appoint a Board placing on it some of the experts ready to their hand, some of the retired Indian Forest officers of experience, who form a valuable asset to which the country can turn if it cares to. We should like to see the Board request these officers to draw up a preliminary working scheme for treating certain areas, to be put into force as soon as drawn up. We should like to see a sum of money provided for this propose; 'twould be but the merest trifle from the great national purse. It would not be long before the question of the advisability, applicability and practicability of the afforestation of Great Britain answered itself, the answer carrying with it a commencement of the settlement of the unemployed question—a settlement of which no Government has yet provided even the smallest solution to.

E. P. STEBBING.

Notes on Sandal.

By M. Rama Rao, Madras Forest Department.

Mr. P. M. Lushington's article on this subject in the January number of the *Indian Forester* will doubtless be read with much interest and profit by those who, like myself, have sandal tracts to manage. Mr. Lushington has already contributed a great deal to our scanty knowledge of the habits and growth of sandal, and I hope that as he is still earnestly studying the subject, he will give us more information still. In the meantime I venture to offer the following remarks on the subject for the perusal of Indian Foresters:—

I.—Root-parasitism.

2. Since writing my note that appeared in the September number of the *Forester*, I have continued the investigation and study of this peculiar habit of the sandal, and have found unmistakable evidences of its parasitism on the roots of upwards of seventy different species of plants belonging to various natural orders. In fact, I have hardly come across a plant growing within reach of a sandal whose roots have not borne traces of attack by sandal roots, though some species are more largely preyed upon than others.

As a detailed account of my investigations in this direction will form the subject of a separate record, there is no need to enter into details here. It may, however, now be safely asserted that the root-parasitism of sandal discovered so far back as 1871 by Mr. Scot, and altogether ignored till very recently, when Mr. Barber

re-discovered it, *if I may say so, is now beyond all doubt an* established fact, and that it plays a part in the growth and development of the tree the importance of which has never hitherto been suspected.

II.—CONGENERS.

3. I am now in a position to endorse all that Mr. Lushington has said on this head, since I have found the root connection of sandal with all the species mentioned by him except Terminalia chebula and Acacia sundra, which I have not yet examined. But I see no reason to exclude Litsœa zeylanica and Albizzia amara from the list of congeners, for they are not only associated with the sandal but have also root connection with it, although Albizzia amara is not commonly found on the upper slopes and plateau of the Javadis.

4. I would add the following to the list of congeners given in my article above refered to. Every one of these species was found to have been attacked by the sandal roots :—Terminalia arjuna [along streams and in moist places], (2) Wrightia tomentosa, (3) Mimusops indica, (4) Alseodaphne semicarpifolia, (5) Diospyros montana, (6) Cudrania javanensis, (7) *Kattu tamattai* [a large leguminous climber with purple flowers and broad and long pods], (8) *Maniputtan* [Tamil], a woody shrub, (9) Ventilago madraspatna , (10) Cipadessa fruticosa, (11) *Karallan kodi* [Tamil], an asclepiad resembling somewhat Hemidesmus indicus, (12) Sida carpinifolia, (13) Casearia tomentosa, (14) Elœodendron roxburghii, (15) streblus asper, (16) Anona squamosa, (17) Phœnix sylvestris, (18) Clitorea ternatea, (19) Azima tetracantha, (20) Protium caudatum, (21) Adhatoda vasica, (22) Alangium lamarckii, (23) Cucurbita dioica, (24) Grewia sp. [Tamil Pannipudukkan], (25) *Sittavarai* in Tamil, a leguminous herbaceous twiner with a tuberous root, (26) Tinospora cordifolia, (27) Acalypha fruticosa, (28) Acalypha indica, (29) Plumbago zeylanica, (30) Achyranthus aspera, (31) Prickly pear [Opuntia dillenii], (32) Jatropha curcas, (33) Ficus bengalensis, (34) *Pandal [avarai* oleguminous climber grown in gardens], 35) Morinda citrifolia, (36) Ochalandra rheedii, (37) Holoptelca integrifolia, (38) Grasses such as Cynodon dactylon, and (39) Elensine Egyptiaca. Some of the above species are very sparingly attacked, while others are extensively so by sandal roots. To the above may be added (40) Inga dulcis, (41) Eucalyptus globulus, (42) Dalbergia sissoo, and (43) Thespesia populnea, all of which were found largely connected by their roots with the sandal in the Forest compound at Denkanicotta.

I have also observed sandal associated with teak (Tectona grandis), blackwood (Dalbergia latifolia), Pterocarpus marsupium, Canthium parviflorum, Ixora parviflora, Cordia myxa, Cordia *vestita*, Buchanania latifolia, Cassia fistula, and Agave americana, and though I believe they are attacked by sandal, I have not examined their roots.

III. – GIRTH CLASSES AND WEIGHT OF SCENTED WOOD.

5. A register showing the girth at breast height and weight of scented wood of each tree felled has been maintained in each range of the Salem District since 1901-02. I take the figures of the Tirupatur Range as being the most accurate, the operations having been conducted by an Extra Assistant Conservator, and frequently inspected by myself. The subjoined table No. 1, based upon the results of the fellings of 19 ·2-03 and 1903--04, shows the yield of the several girth classes at different altitudes on the Salem Javadis. The altitudes are taken from the 4-inch maps prepared by the Survey of India party. As the trees selected for felling during 1902-03 were restricted to those of and above 40 inches in girth, and in 1903-04 to trees above 36 inches, the lower girth classes are but thinly represented and do not admit of a fair comparison with the figures given by Mr. Lushington. Such as they are, they show that the yield of scented wood on the Javadis is much greater in almost all girth classes than in the sandal tracts of the North Coimbatore District, irrespective of the differences in altitude As far as I can gather from Mr. Lushington's notes, the conditions of growth of sandal in the Coimbatore District are all that could be desired, and I therefore take it that they are not less favourable than those obtaining on the Javadis. If this were so, the causes for the smaller yield of scented wood in Coimbatore require to be studied. Prior to the introduction of detailed instructions in 1895-96 and their stringent enforcement in the Salem District, the yield of scented wood was no better but was perhaps worse than in the Coimbatore District.

TABLE No. I.

Table showing yield of scented wood (heartwood) in the several girth classes of sandal trees growing at different elevations on the Salem Javadis, ascertained from fellings of 1902-03 and 1903-04.

Girth classes.	Altitude (elevation above mean sea-level). 3,600.′		3,500.′		3,400.′		3,300.′		3,200.′		3,100.′		3,000.′		2,900.′		2,800.′		2,700.′		2,600.′		2,500.′		2,000.′		Average yield per tree of each girth class irrespective of altitude.	
	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average weight of scented wood.	No. of trees.	Average calculated by totalling weights of each tree and dividing by total No. in the girthclass.
		lbs.		lbs.		lbs.		lbs.		lbs.		lbs.		lbs.		lbs.		lbs.		lbs.		lbs.		lbs.		lbs.		
16″—18″ ...	...	...	...	...	...	...	‡1	126·0	...	...	...	...	...	...	...	...	...	...	...	...	1	35·0	...	...	...	...	2	81
19″—21″ ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
22″—24″ ...	...	...	...	...	...	...	...	...	‡1	84·0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	84·0
25″—27″ ...	...	...	...	...	...	...	...	...	1	238·0	‡3	89·3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	126·0
28″—30″ ...	...	...	...	...	2†	184·0	...	...	‡3	126·0	‡2	97·5	...	...	...	...	...	...	...	...	1	268·0	...	...	...	...	8	147·0
31″—33″ ...	...	...	...	...	...	...	...	...	‡2	134·0	‡2	67·5	...	...	...	...	...	...	‡1	42·0	...	...	...	...	...	...	5	89·0
34″—36″ ...	...	...	...	...	...	...	...	...	1	632·0	...	...	...	...	...	...	...	...	...	...	2	654·0	...	...	...	...	3	647·0
37″—39″ ...	7	329·3	...	...	4	354·0	6	265·6	48	252·2	17	289·8	...	...	7	331·7	6	285·0	1	402·0	7	388·5	...	...	...	...	103	299·0
40″—42″ ...	2	655·0	*1	137·0	8	509·7	10	299·1	18	300·5	14	213·8	5	343·2	7	318·6	5	466·0	...	...	1	231·0	...	...	2	266·5	73	318·0
43″—45″ ...	1	1,429·0	1	437·0	1	557·0	11	380·4	13	349·5	8	268·5	6	419·6	1	439·0	2	556·0	...	...	2	434·0	1	408·0	...	...	47	396·0
46″—48″ ...	2	434·5	...	...	3	300·0	6	349·1	4	536·5	5	384·0	3	319·0	...	...	...	...	...	...	1	522·0	...	...	...	...	24	392·0
49″—51″ ...	...	...	...	...	...	...	2	686·5	1	479·0	2	571·0	2	487·5	...	...	...	...	...	...	1	545·0	...	...	...	...	8	529·0
52″—54″ ...	...	...	...	...	1	572·0	2	366·5	1	322·0	11	,442·0	...	...	...	...	...	...	...	...	1	887·0	...	...	...	...	6	659·0
55″—57″ ...	...	...	...	...	...	...	...	...	...	...	‡3	715·3	1	359·0	...	...	...	...	...	...	1	389·0	...	...	...	...	5	578·9
58″—60″ ...	...	...	...	...	1	735·0	...	...	§3	719·6	...	...	...	...	...	...	...	...	...	...	1	601·0	...	...	...	...	5	699·0
61″—63″ ...	...	...	...	...	...	...	...	...	1	496·0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	496·0
64″—66″ ...	...	...	...	...	...	...	...	...	...	...	2	495·5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	495·5
67″—69″ ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
70″—72″ ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
73″—75″ ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	821·0	...	...	...	...	1	821·0

* Prematurely dead tree. † One tree dead and yielded 45 lbs. only. ‡ Dead trees. § One of the trees yielded 1,135 lbs. § One of the trees yielded 1592 lbs, while another yielded only 186 lbs.

6. This table does not permit us to deduce any useful and precise generalisations of scientific value as regards the influence of altitude on the outturn of scented wood (heartwood), nor does it enable us to fix, with any shown of scientific accuracy, the yield of scented wood for each girth class, although it may justify a very rough estimate such as would serve for practical purposes of check and control over the work of indifferent and careless subordinates in exploiting the wood. The variation in the outturn is very great, not only between the different girth classes, but also in the individuals of the same girth class. In Mr. Lushington's opinion "figures of this sort only prove the immense *variation* of sandal *even when grown under similar conditions.*" The italics are mine. This, in other words, means that the sandal tree behaves differently from all other tree species, a proposition which it is difficult to accept unless and until it is established by further investigation and study. Mr. Lushington presumably assumes that the trees for which he has given figures of yield in each coupe were all grown under *similar conditions.* I do not know whether he has taken any account of the different species of trees associated with the sandal and their density in the coupes he refers to. It is hardly likely that he could have done so, considering the extremely irregular and patchy nature of sandal occurrence in unreserves and in the neighbourhood of villages and cultivation where the interference of man and beast with forest growth is so great, and where, therefore, it is impossible that all sandal trees felled could have grown up amidst congeners of similar species and density. If this were so, then it cannot be said that all the trees on whose outturn of heartwood Mr. Lushington bases his opinion were grown under "similar conditions." My belief is strong, nay, it is almost a conviction with me, that the influence of congeners on the growth and development of the sandal tree and on the production of scented wood is as great as the other conditions of growth such as soil, climate and altitude, which last may even be said to be secondary in its importance to that of the "congeners."

7. So far as the trees on whose yield the above table is based are concerned, I may say that the soil and the climatic conditions of growth were more or less similar, but in respect of congeners there has been considerable difference, and I attribute the great variation in the yield mainly to this difference. I base this statement on my general observations and nine years' experience of sandal on the Javadis.

8. The following inferences may be fairly drawn from the above table:—

(*a*) The natural sandal is mostly found at altitudes between 2,600 and 3,900 feet on the Javadis (Salem).

N. B. The area of sandal above 3,400 feet is very small.

(*b*) The average yield of scented wood increases as the girth increases, although not in any definite and fixed proportion.

In making this inference it is only fair to leave out of account abnormally large or small yield of some trees, as in the case of girth classes 31″—33,″ 34″—36,″ and 55″—57.″

(c) Mature trees are mostly confined to girth classes 37″—39″ to 46″—48,″ and the number of higher girth classes gradually diminish up to 60,″ above which the trees become too few to be taken into account in practical calculations.

(d) From the above it may be broadly stated that the maximum limit of girth of exploitable trees may be fixed at 5′, the minimum being 3′. This holds good only to the Javadis. Of course, dead, declining and damaged trees below this minimum must obviously be exploited, but they need not be reckoned with in making calculations for framing a working scheme for sandal.

(e) The influence of altitude on the outturn of scented wood in the several girth classes is not clear. The figures given by Mr. Lushington lead one to the same conclusion as regards sandal areas in Coimbatore also. But in the absence of reliable information as to the existence of similar conditions of growth, no comparison is possible, much less a generalisation.

9. As figures of yield of scented wood on the Chitteris, Melagiris and Kollimalais, as furnished by Range Officers are available, it may not be uninteresting to compare them with those of the Javadis. The subjoined table exhibits them.

TABLE No. II.

A comparative statement of the yield of scented wood of the several girth classes of sandal grown on the Javadis, Melagiris, Chitteris and Kollimalai Hills.

LOCALITY.	JAVADIS.		MELAGIRIS.		CHITTERIS.		KOLLIMALAIS.			KOTADAI COUPE (NORTH COIMBATORE).	
Elevation.	2,500' to 3,600.'		2,800' to 4,000.'		2,500' to 3,700'.		3,000' to 4,200'.			About 4,000.'	
Girth class.	No. of trees.	Average yield in lbs.	No. of trees.	Average yield in lbs.	No. of trees.	Average yield in lbs,	No. of trees.	Average yield in lbs.		No. of trees.	Average yield in lbs.
	1902-03 and 1903-04		1901-02		1901-02		1900-01 and 1901-02				
16"—18" ...	2	81	...	...	5	42	...			25	17
19"—21" ...	...	...	16	33	14	61	2	76	1900.	25	37
22"—24"	1	84	36	67	39	74	29	65		25	69
25"—27" ...	4	126	17	78	11	86	16	71		25	103
28"—30" ...	8	147	12	77	26	130	8	93	1901-02.		
31"—33" ...	5	89	19	113	11	144	23	110		25	180
34"—36" ...	3	647	11	161	6	185	16	119			
37"—39" ...	103	299	3	135	2	270	12	119			
40"—42" ...	73	318	1	176	4	298	5	142		25	296
43"—45" ...	47	396			1	247	1	299			
46"—48" ...	24	392					2	227			
49"—51" ...	8	529									
52"—54" ...	6	659									
55"—57" ...	5	578									
58"—60" ...	5	699									
61"—63" ...	1	496									
64"—66" ...	2	496									
67"—69" ...	1	...									
70"—72" ...	...	...									
73"—75" ...	...	821									

N.B.—The figures for Coimbatore are taken from Mr. Lushington's Notes published in the January number of the "Forester."

10. A glance at this table shows that on the Javadis not only is the outturn of scented wood far and away the largest even as compared with the highest yield recorded for the Kotadai coupe of the north Coimbatore District, but also that the girth classes higher than 48″ have been mainly confined to that range. From my personal knowledge of the sandal tracts of the Melagiris and Kollimalais, I must say that the sandal is growing on them in more open forests and is less efficiently protected from the mischief of man, both by way of lopping the crowns and damaging the bark. These causes coupled with differences in the conditions of growth such as rainfall, soil and climate, and probably also with inefficient supervision over coolies employed in squaring and cleaning the wood, account for the comparatively low yield of scented wood on these two hill ranges. Those who have not personally conducted and supervised the felling and cleaning of sandalwood can hardly realise the amount of wastage of heartwood caused by the hill tribes who are generally employed on the work partly through carelessness and indifference and in part deliberately to reduce the size of logs so that they may carry them down the hills with ease. Even on the Javadis the average outturn of heartwood prior to 1896 rarely exceeded 75 lbs. whatever the size of trees felled, though only trees above 30″ girth had been ordered to be felled, but since that year the marking and felling have been conducted by Foresters and Deputy Rangers under the personal supervision of an Extra Assistant Conservator, who inspects and checks the majority of the trees marked annually.

11. In Mr. Lushington's classification girth classes differ from each other by 3″ up to 24,″ and by 6″ above that and below 36″, while all above 36″ are grouped into one class. This renders it impossible to ascertain the maximum girth attained by sandal in the Coimbatore sandal areas. Since the proportion of scented wood increases directly as the girth up to a certain limit, it is desirable to group the girth classes uniformly, so that each of them differs from the next higher or lower one by 3″. This is all the more necessary, because it is one of our efficient means, if not the only one, of checking the outturn of wood collected under the supervision of subordinates who are not above temptation.

IV.—PROPORTION OF SCENTED WOOD TO THE TOTAL WEIGHT OF HEART WOOD-BEARING PARTS INCLUDING BARK AND SAPWOOD.

12. Taking advantage of the current official year's sandal fellings on the Javadis, I had such portions of the trunks, branches and roots of six sandal trees as contained heartwood weighed with bark and sapwood on, and after they were squared and cleaned, the heartwood alone was weighed separately.

The subjoined Table No. III shows the results.

TABLE NO. III.

Showing percentage of scented wood by weight to the total weight of heartwood bearing portions of trunks, branches and roots with bark and sapwood on.

Serial number of tree.	Locality. Name.	Locality. Altitude.	Girths of standing trees at 4' from base.	TRUNKWOOD. Weight with bark and sap-wood immediately after felling.	TRUNKWOOD. Weight of scented wood soon after squaring and cleaning.	TRUNKWOOD. Percentage of columns 5 and 6.	BRANCHWOOD. Weight with bark and sap wood soon after felling.	BRANCHWOOD. Weight of scented wood soon after squaring and cleaning.	BRANCHWOOD. Percentage of columns 8 and 9	ROOTWOOD. Weight with bark and sap-wood soon after felling.	ROOTWOOD. Weight of scented wood soon after squaring and cleaning.	ROOTWOOD. Percentage of columns 11 and 12.	TOTALS OF ALL PARTS. Trunk, branch and rootwood, together with bark and sap-wood.	TOTALS OF ALL PARTS. Scented wood of trunk, branch and rootwood together.	TOTALS OF ALL PARTS. Percentage of columns 14 and 15	PROPORTION OF SCENTED WOOD IN THE TRUNK, BRANCHES AND ROOTS TO THE TOTAL SCENTED WOOD. Percentage of col. 6 to col. 15	PROPORTION … Percentage of col. 9 to col. 15	PROPORTION … Percentage of col. 12 to col. 15.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
				lbs.	lbs.		lbs.	lbs.		lbs.	lbs.								
1	Kembungudi.	,600	39"	1,257	398	31 66	626	141	22·52	490	191	47·75	2,283	730	31·97	54·5	19 3	26·2	These 2 grown amidst a fairly dense forest growth with Albizzia odoratissima, Litsœa zeylanica, Streblus asper, Cudrania, Acacia climbers &c.
2	Do.	3,600'	38"	1,625	476	29 29	705	170	24·11	390	225	57·70	2,720	871	32 02	54·7	19·5	25·8	
3	Do. ...	3,600'	40"	581	267	45 95	398	75½	19·00	455	84	18·46	1.434	426½	29 74	62·6	17·7	19·7	Growing in the open in a hedge about 20 yards from above 2 trees.
4	Pudur.	3,000'	38"	900	418	46·44	110	17	15 45	105	48	45·71	1,115	483	43·31	86·5	3·5	a 10·0	
5	Do. ...	3,000'	37"	708	291	41·10	56	7½	13 40	115	31	27·00	879	329½	37·48	88·3	2 3	b 9 4	
6	Do. ...	3,000'	39"	498	209	41·97	264	40½	15·34	105	37½	35·71	867	287	33 10	72·8	14·1	c 13·1	

N. B.—For the purpose of this experiment the whole bole to its extreme top point up to which heartwood extended was taken as trunkwood, branchwood including only the actual lateral branches.

(a) Grown associated with Albizzia odoratissima and Acacia climbers. (b) In a group of sandal trees with Acacia climbers.
(c) Do. do. do. and pongamia glabra.

13. The proportion of scented wood in the trunks of the first two trees was the lowest, while that in the branches and roots was the highest. These two trees were immature at the time of felling, and were growing vigorously on a rich deep ferruginous loam mixed with a few stones and associated with a fairly dense growth of trees and shrubs. The other four trees were growing in the open with comparatively fewer associates. Except No. 3 the other trees were at a much lower elevation. The proportion of scented wood in their trunks was the largest, and pretty constant too, but that in the branches and roots was much lower than in the first two trees and more variable It is significant that the three trees grown at the lower elevation show a much larger percentage of scented wood in their trunks and much smaller percentage of it in the branches and roots than those grown at the higher elevation. This appears to confirm Mr. Lushington's observation that scented wood begins to form more quickly at lower elevations but to increase less as the girth of the tree becomes bigger.

14. It is worthy of attention that the two trees of 38" and 39" girth at the higher elevation gave a much larger outturn of scented wood than trees of similar girths at the lower elevation, but the 40" girth tree grown in the open at the higher elevation contained a much smaller quantity of scented wood than trees of smaller girths grown at the same or even lower elevation but with a larger number of congeners. Here there are two factors, *viz.* (1) difference of altitude and (2) difference in the number and variety of congeners. What influence these two factors jointly and severally exert on the outturn of scented wood it is difficult to say, although it may generally be affirmed that they do influence the development of scented wood. Judging from the figures in Table No. I, I am inclined to think that the number and variety of congeners exert a greater influence on the development of scented wood than does altitude. This view finds support in the smaller yield of tree No. 3 in the above Table No. III, if it is justifiable to take the yield of a single tree for making such a generalisation.

15. I was led to made the experiment of determining the outturn of scented wood in trunks, branches and roots separately because the heartwoods of the different parts of a sandal tree command different prices in the market, the trunk-wood being of the highest value, sound branchwood *coming* next, and rootwood the lowest. In common practice, trunk and branchwood go together as billet wood, and rootwood stands by itself. From Table No III it will be seen that the percentage of scented rootwood varied from 20" to 26" at Kambugudi, while it was only 9" to 13" at Pudur.

16. Having thought it unsafe to rely entirely on the yield of these few trees, I have collected figures showing the percentage of scented rootwood to the total outturn of scented wood for a number of trees of each girth class from all the principal sandal-producing hill ranges of the Salem District.

The following table exhibits them in parallel lines to facilitate comparison :—

TABLE No. IV.

Statement showing proportion of scented rootwood to the total outturn of scented wood in sandal on the principal sandal-producing hill ranges of the Salem District.

Girth classes.	SALEM JAVADIS.				MELAGIRIS.				CHITTERIS.				KOLLIMALAIS.			
	No. of trees.	Average yield of heartwood including rootwood.	Average outturn of rootwood only.	Percentage of scented rootwood.	No of trees.	Average outturn of scented wood including rootwood.	Outturn of scented rootwood only.	Percentage of root-wood to total out-turn.	No. of trees.	Average total out turn of scented wood.	Average outturn of scented root-wood.	Percentage of root-wood to total out-turn.	No. of trees.	Average total out-turn of scented wood.	Average outturn of scented root-wood.	Percentage of root-wood to total out-turn.
		lbs.	lbs.			lbs.	lbs.			lbs.	lbs.			lbs.	lbs.	
16"—18"	2	81	19	23·4	...	...	...	...	5	42	13	30·9				
19"—21"	...	...	...	..	16	33	4	12·1	14	61	21	34·4				
22"—24"	1	84	14	16·6	36	67	9	13 4	34	74	19	25·7				
25"—27"	4	126	17	13·5	17	78	9	11·5	11	86	24	27·9				
28"—30"	8	147	28	19·0	12	77	10	13·0	26	130	27	20·8	8	93	25	26·9
31"—33"	5	89	11	12·4	19	103	11	10·7	11	144	39	27 1	23	110	26	23 6
34"—36"	3	647	72	11·1	11	161	16	9·9	6	185	30	16·2	16	119	31	26 0
37"—39"	103	299	40	13·4	3	135	12	8 9	2	270	48	17 8	12	119	27	22·7
40"—42"	73	318	45	14·1	1	176	14	8·0	4	298	43	14·4	5	142	26	18·3
43"—45"	47	296	51	12·9	..	...	...	...	1	247	51	20 6	1	299	79½	26.6
46"—48"	24	392	48	12 2	...	...	...	...	...	...	...	...	2	227	59½	26.2
49"—51"	8	529	62	11·7												
52"—54"	6	659	96	14 6												
55"—57"	5	578	81	14·0												
58"—60"	5	699	115	16 4												
61"—6 "	1	469	63	13·4												
64"—66"	2	496	112	22·5												
73"—75"	1	821	81	9·9												
Average percentage.	...	...	...	14·8	...	...	...	10·9	...	...	...	23·5	...	...	...	24.3

17. From the above table it is evident that the proportion of scented wood in roots to the total scented wood of a tree is lowest on the Melagiris, while it is highest on the Kollimalais. The Chitteris approximate the Kollimalais, whereas the Javadis approach the Melagiris in this respect. Even on the Javadis, trees grown at 3600' show a higher proportion of scented wood in roots than those of lower elevations, *vide* column 19 of Table No. III. At first sight, this leads one to suspect that the altitude influences largely the development of the scented wood in the roots of sandal; but I am not quite sure whether the depth and friability of and moisture in the soil do not play a more important part than the altitude. As far as I have seen, the soil at higher altitudes on the Javadis and Kollimalais are much deeper, more friable and humid with a smaller admixture of small stones than the soil at lower elevations, where it is generally much drier and more stony. The sandal tracts on the Melagiris have, roughly speaking, a much drier and more stony soil except on the plateau.

18. It may be inferred from Table No. IV, making due allowance for obvious abnormalities, *that the proportion of scented wood in the roots to that of a whole tree is fairly constant in a given locality with a small range of variation.* Thus, for instance, in the case of the Javadis, out of the 17 girth classes only in three did scented rootwood vary from 19 to 23·4 per cent, in two it was 16·5 per cent, and in all the rest it was between 10 and 14·6 per cent of the total scented wood. In the case of the Melagiris, the variation between all the girth classes was from 8 to 13·4 per cent. Out of the 10 girth classes on the Chitteris, in four it varied from 27·1 to 34·4, in three from 20·6 to 25·7, and in the rest from 14·4 to 17·8. On the Kollimalais, in six out of the seven girth classes it varied from 22·7 to 26·9 per cent, while in the remaining one it stood at 18·3 per cent.

19. I think it is also permissible to infer from these figures that *the proportion of scented rootwood to the total scented wood of a tree varies in different localities.* In the Salem District the average precentage may be fixed at 15 for the Javadis, 11 for the Melagiris and 24 for the Chitteris and Kollimalais.

V.—Rate of growth.

20. In dealing with the *rate of growth*, we must take it under two heads (a) *The Terminal or Height growth*, and (b) *The Lateral or Girth growth.* As far as I am aware, we have no reliable data under these heads. Mr. Lushington has given some useful information on the subject in his "Notes on the Sandal Tree in Southern India," but it is not complete and conclusive enough to be considered as definitely established. He has assumed each concentric ring to represent one year's growth, but whether it really represents one year's growth or not has not been clearly proved, and until such proof is forthcoming, this assumption must be held to rest on no scientific basis. There being no sandal plantations of different ages in the Salem District except the relics

of an old one started in 1873 in an open glade and abandoned in 1876, on the Melagiris, I am unable to furnish any reliable data of scientific value.

21. I have collected a few notes from ring countings on the Javadis, and though they may be too inadequate to draw final conclusions from, yet may suffice to compare with Mr. Lushington's figures. Of course, I assume, as Mr. Lushington has done, that each concentric ring represents a year's growth, there being no other alternative at present. In order that precise information may be gathered as to the height growth and girth growth separately, I arrange my scanty notes under these two heads in the hope that they will lead to further investigation and observation.

V. (A).—Rate of Terminal or Height Growth.

22. While camping at Chittoor on the Javadi plateau at an altitude of 3,200' in the latter part of February last, I had felled sandal trees from 3" to 21" in girth at 4' from the ground, and I measured the lengths of their boles, the heights up to which scented wood extended, the number of concentric rings, and other particulars.

The subjoined Table No. V. (A.) gives the particulars :—

TABLE No. V. (A.)

Serial number of tree.	Girth at base.	Girth at 4' from base.	Height of bole.	Number of rings on radius.	IN THE BOLE. Diameter of wood at base.	IN THE BOLE. Diameter of heart-wood at base.	Height up to which heart-wood extended up the bole.	Condition of heart-wood or degree of development of scent.	Weight of cleaned heart-wood in lbs.	Number of rings per inch of mean radius.	
1	3½"	3"	7'	10	1"	...	...	...	...	20	These trees were growing on a pretty steep western slope about two furlongs below Chittoor at 3,100 feet, with the usual congeners such as Litsea zeylenica, Acacia climbers, Albizzia odoratissima (sparse), Zizyphus œnoplia and Zylopyra, Scutia indica, *Porumbal* (Tamil), &c. Ground fairly well sheltered and cool. Soil fairly deep red loam with admixture of stones.
2	7"	6"	9'7"	14	2"	¾"	8"	Incipient and scentless.	...	14	
3	12"	9"	15'	23	3⅝"	$1\frac{1}{16}$	4"	Very faint scented.	$\frac{11}{16}$	13	
3	No. 3 at a height of 4' from base			15	2⅞"	...	...	—	...	13	
4	18"	12"	17'8"	26	5½"	$2\frac{3}{16}$	6'9"	Faint scented ...	2·4	9	
4	At a height of 4' from base			17	$3\frac{5}{16}$"	...	—		...	10	
5	18"	15"	16'	33	5⅝"	3⅜"	13"	Fairly scented ...	14	11	
5	At a height of 4' from base			28	4⅛"	1⅛"	...	...	...	13	
5	Do.	13"	do.	15	3"	...	...	...	...	10	
6	21"	18"	17'	33	6"	2⅜"	9'2"	Fairly scented ...	12·4	11	
6	At a height of 4' from base			26	4⅝"	...	—	...	...	11	
7	25½"	20½"	13'4"	37	7¾"	4"	12'9"	Fairly good ...	35·8	10	
7	At a height of 4' from base			32	5¾"	...	...	...	...	11	

It would be obviously unfair to draw any generalistations from the above table, as the figures under each girth are taken from only one tree. It will, however, serve to give a rough idea, a very rough one perhaps, of height attained at a given age, the height to which heartwood extends, and the weight of heartwood. In these trees there were hardly any branches owing to the pretty dense growth of other species amidst which they were growing, and hence also the great lengths of bole as compared with those given by Mr. Lushington on page 18 of his Notes already referred to.

23. Taking tree No. 4 and averages of Nos. 5 and 6 in the above table and comparing them with the averages of Mr. Lushington's No. IV, V, VIII and IX and of VI and VII, we find that a tree of 26 years on the Javadis developes about the same thickness of wood, but the formation of heartwood is slower, while height growth is greater; but in the case of trees 33 years old, Bylur trees show a distinctly greater development. This comparison is obviously inconclusive for the reason already stated.

24. As it is of importance to determine the height up to which workable heartwood extends in the stems, I may give figures of six other larger trees, three felled at Kambugudi at an altitude of 3,600 feet, and three at Pudur 3,000 feet. The following Table No. V. (B) shows the particulars :—

TABLE No. V. (B.)

Showing heights or lengths up to which workable heartwood extended in the stems and branches of sandal trees on the Javadis.

Serial number of trees.	Locality and altitude.	Girth of standing trees at base.	Girth of standing trees at 4' from base.	MEASUREMENTS OF CLEANED HEARTWOOD (SCENTED) IN — Stems (trunks). Length or height up to topmost point.	Stems (trunks). Girth at base.	Stems (trunks). Girth at top.	Branches. Branch No. 1. Length.	Branch No. 1. Middle girth.	Branch No. 2. Length.	Branch No. 2. Middle girth.	Branch No. 3. Length.	Branch No. 3. Middle girth.	Branch No. 4. Length.	Branch No. 4. Middle girth.	Branch No. 5. Length.	Branch No. 5. Middle girth.	Branch No. 6. Length.	Branch No. 6. Middle girth.	Branch No. 7. Length.	Branch No. 7. Middle girth.	Branch No. 8 Length.	Branch No. 8 Middle girth.	Branch No. 9. Length.	Branch No. 9. Middle girth.	Number of rings on mean radius.	Remarks.
1A	Kambugudi, altitude 3,600.	41½"	39"	23'3"	30"	7½"	9'6"	11"	3'6"	4"	3'4"	6"	4'2"	6"	5'11"	9"									50	The tree forked at the base into 4 stems.
" B		26"	25"	20'10"	17"	1"																				
" C		24"	23"	9'0"	14"	1"																				
" D		21"	19"	7'7"	14"	4½"	5'9"	6"																		
2		41"	38"	3'77"	29"	3"	10'10"	10"	4'9"	8"	6'10"	6½"	6'11"	14"	6'4"	11"	5'10"	11"	[illegible]'5"	12"	5'0"	6½"	5'9"	4"	53	
3		44"	40"	16'8"	37"	4"	6'4"	5"	3'	13"	31'0"	7½"	1'11"	6"	2'8"	10"	...	6"	2'6"	4½"	3'3"	4"	5'1[illegible]"	1"	56	
4	Pudur 3,000.	41"	38"	27'4"	30½"	9"	3'9"	8"	2'11"	5"	1'11"	5"	2'10"	5"												
5		40"	37"	24'9"	28"	5½"	5'11"	5½"	1'3"	4"																
6		41"	39"	2[illegible]'6½"	34"	3"	3'1"	6½"	2'1"	7"	2'2"	5"	2'4"	8"												

Of the three trees grown at Kambugudi, the first two were amidst tall and fairly dense congeners, while the third tree was in an open hedge about 20 yards further off.

25. It is evident from the above table that sandal attains a good height on the Javadis and that workable heartwood in some cases extends even up to 40′ in height. The figures are not those of the tallest trees, but may be said to represent the averages in the localities where they were found. Like other trees sandal attains its maximum height growth amidst tall and dense congeners, while in scrubs and open lands its average height rarely exceeds 20′ from the base to the tip of its crown. This fact is well illustrated at Kambugudi itself, where we find the tallest trees – a few of them being more than 60′ amidst Albizzia odoratissima, Diospyros montana, Litsœa zeylonica, Acacia climbers, &c., to the north of the village, while on an open and exposed slope about 1½ furlongs to the south of the above locality, there are hardly any trees above 20′ in height. My observations all over the Salem District and at all elevations between 950′ and 4,600′ confirm this fact.

V. (B).—RATE OF LATERAL OR GIRTH GROWTH.

26. According to Table No. V. (A.) the lateral development of sandal is very slow in its early stages up to 23 years, and thereafter becomes more rapid. Taking the last three trees in that table, we find that the number of rings on an inch of *mean radius* varies between 10 and 11. Assuming that each ring represents a year's growth, we have a girth development of $6\frac{2}{7}''$ inches in 10 or 11 years.

27. In 1896-97 I counted the rings on transverse sections of some sandal trees near Kambugudi (3,600)′ and Pudur (3,000′). I selected the broadest radius on each section and counted the rings thereon. The number of rings on an inch varied from 5 to 9 at Kambugudi and 8 to 12 at Pudur. In the former place the trees were growing on a rich deep soil associated with a number of congeners, while at the latter place they were in an open scrub jungle in an exposed and poor soil. Taking both together the average number of rings on an inch of the *broadest radius* was 8, or, in other words, the girth growth was $6\frac{2}{7}''$ in every 8 years. As will be shown later on, this cannot be taken as a correct basis for practical calculations.

28. While supervising the exploitation of sandal trees in November last, I again counted the rings at Kambugudi and Palayapalayam (2,700′), and the result is recorded in the subjoined Table No. VI. I have shown in separate columns the average number of rings on an inch of the *mean radius* as well as on the *broadest radius*. In almost 90 per cent of the trees felled and examined by me I have found the rings very irregular and wavy, and hence I think it incorrect to take the number of rings found on the *broadest radius* as representing the actual growth. The actual and true growth must be taken as that represented by the mean radius or diameter, and that this is so is confirmed by the appreciable differences between the figures in columns 6 and 8 of the table :—

Table No VI.

Serial number of trees.	Girth.	Average radial thickness of bark.	Mean radius of wood. Length.	Mean radius of wood. Member of rings on	Mean radius of wood. Average number of rings on an inch.	Broadest radius. Length.	Broadest radius. Average number of rings on an inch.	Locality and altitude.	Remarks.
1	2	3	4	5	6	7	8	9	10
1	$18\frac{3}{4}''$	$\frac{1}{4}''$	$2\frac{3}{4}''$	31	11	$2\frac{1}{2}''$	9	Kambugudi 3,600′	Transverse section of a branch.
2	$21\frac{1}{2}''$	$\frac{1}{4}''$	$3\frac{3}{16}''$	38	12	$4''$	9	Ditto	Ditto.
3	$21\frac{1}{2}''$	$\frac{1}{4}''$	$3\frac{5}{16}''$	25	8	$2\frac{1}{4}''$	8	Ditto	A forked branch at base of section.
4	$37\frac{1}{2}''$	$\frac{1}{2}''$	$5\frac{1}{4}''$	43	8	$7\frac{1}{4}''$	6	Ditto	At a height of 5′ from base.
5	$35''$	$\frac{1}{4}''$	$5\frac{9}{32}''$	46	9	$5\frac{1}{2}''$	9	Ditto	Ditto 4′10″ ditto.
6	$26\frac{1}{2}''$	$\frac{1}{4}''$	$4''$	36	9	$3\frac{3}{4}''$	9	Ditto	Ditto 7′11″ ditto Top section of No. 5.
7	$10''$	$\frac{1}{4}''$	$1\frac{11}{32}''$	15	11	$1\frac{1}{2}''$	10	Ditto	A top branch of Nos. 5′ and 6 at a height of 17′ from base.
8	$30''$	$\frac{1}{4}''$	$4\frac{1}{2}''$	50	11	$5''$	10	Ditto.	
9	$36''$	$\frac{7}{16}''$	$5\frac{9}{32}''$	46	9	$5\frac{4}{16}''$	9	Palayapalayam 2,700.′	At a height of $5\frac{3}{4}'$ from base.
				Average	10		8·8		

From this table we see that for every increase of 2″ in diameter, that is, 6$\frac{2}{7}$″ in girth calculated on the *mean radius*, sandal requires 10 years, whereas if the rings on the broadest radius be taken as the basis, it would require only 8 8 years. This difference, though small at first sight, would in the case of trees of, say, 36″ in girth (11·4″ diameter), amount to 7 years, and this in my opinion is not a negligible period. I take 36″ girth as the minimum exploitable size of sandal, because trees below that girth may reasonably be taken as immature on the Javadis, *vide* Table No. I *supra*.

29. Mr. P. M. Lushington found 6$\frac{1}{2}$ to 7$\frac{3}{8}$ rings per inch of radius in the Bhavani Taluk, *vide* page 17 of his "Notes on Sandal in Southern India," and on this basis he calculates that exploitable trees of 32″ in girth would be about 40 years old. Comparing his figures with those noted in the foregoing paragraphs, we arrive at the alternative conclusion that either the sandal grows in the Bhavani Taluk more rapidly than on the Javadis, or he must have counted the rings on the broadest radius. If the latter were the case, his data would be obviously unsuitable for practical calculations, as they would represent the growth of sandal to be much faster than it would really be. Mr. Gamble says in his "Manual" (page 586) on the authority of "Kad-Handi" who, I believe, is Mr. D. E. Hutchins, late of Mysore and now of the Cape Colony, that "Old trees in Mysore were found to give an average of 9·2 rings." This is a nearer approach to the rate of growth on the Javadis than Mr. Lushington's figures.

30. I am inclined to take the rate of girth growth of sandal at 6$\frac{2}{7}$″ in 10 years, as the average number of rings per inch of *mean radius* is found to be 10 on the Javadis. While admitting that the rate of growth varies in different localities according to variations in the conditions of growth, I am inclined to believe that the *average rate of growth* even in the Bhavani Taluk may be found to be somewhat lower than that given by Mr. Lushington if the rings are counted on the mean radius deduced from girth which appears to me to be the correct method.

31. A glance at Table No. I shows that while the *maximum* girth attainable by sandal on the Javadis has been as high as 6$\frac{1}{4}$′ in one isolated instance, trees between 4′ and 5′ girth are not rare, while those below 4′ and above 3′ are quite common. The yield of scented wood of each girth class given in that table justifies the statement that the outturn of scented wood is in direct proportion to the girth of a tree up to a limit of 5′ notwithstanding large variations in some cases; these latter may reasonably be treated as abnormal. In the light of this fact I should have no hestitation in fixing 36″ as the minimum girth of exploitable trees at any rate on the Javadis. To attain this size, a tree requires 57 years, assuming that in 10 years it increases in girth by 6$\frac{2}{7}$ inches or 0·63 inches of girth every year, as

deduced from Table No. VI *supra*. I purpose to deal with the question of Commercial Exploitability of sandal on a future occasion.

(*To be continued.*)

SALEM, 29*th March* 1904.

M. RAMA RAO.

The Flowering of Dendrocalamus Strictus.

THE Myinwa Bamboo (*D. strictus*) has this year flowered fairly extensively in the Ruby Mines District, but not generally over the whole Forest Division; for instance, one can travel through lagre areas of this bamboo forest and not find one flowered stem, and again through others with only a clump flowered here and there. Roughly, the area over which the flowering has taken place is east of the Irrawaddy River and to the south of the Division, namely, that portion adjoining the Mandalay Division. Now I have noticed two curious facts in connection with this flowering. Firstly, that the flowering is seemingly affected by situation, that is to say, the bamboos on the most exposed situations and the hottest localities have flowered, while those in sheltered and cooler areas have not done so. Thus the *D. strictus* bordering sandy creeks, on exposed ridges, along the edge of *Indaing*, round paddy fields, old *yas*, and generally in flat village excluded areas, have flowered, while the rest inside the reserves remain green.

Now this at once leads one to ask the question, will the same thing happen when *B. polymorpha* flowers? Or will that bamboo flower in one gigantic mass wherever it grows in Upper Burma?

Again, will the rest of the *D. strictus* flower next year? It will be interesting to see whether it does or not. I should also mention here that Thanatwa (*B. oliveri*) has also this year flowered sporadically often when growing near *Myin*; but not to any considerable extent. I have also noticed *D. hameltonii* in flower in a good many places.

The second point noticed was that the red jungle fowl, wherever the *myin* has flowered extensively swarmed; this is not to be wondered at considering the immense quantity of food available in the shape of bamboo seed; but now comes the curious point. The hens were all accompanied by chickens *as early as February*. I am certain of this, as on February the 14th I shot a chicken (to make sure); this chicken was one of a brood following a hen and was fully fledged, and was therefore quite three weeks old; since then I have seen numerous broods of all ages following their clucking mothers.

Now the usual season for the red jungle fowl to be sitting is (from my experience) the month of April, after the first jungle fires have been over the ground, as often, when out at work or shooting in April, I have found nests with fresh eggs. That I am correct is upheld by the fact that in the new Forest Rules the close time for jungle fowl is fixed as from March 1st to August 31st. It is evident the plethora of food for chickens has induced the jungle fowl to commence sitting and hatching at least two months earlier than usual. This is a most interesting fact, and I think deserves to be recorded.

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V.—SHIKAR AND TRAVEL.

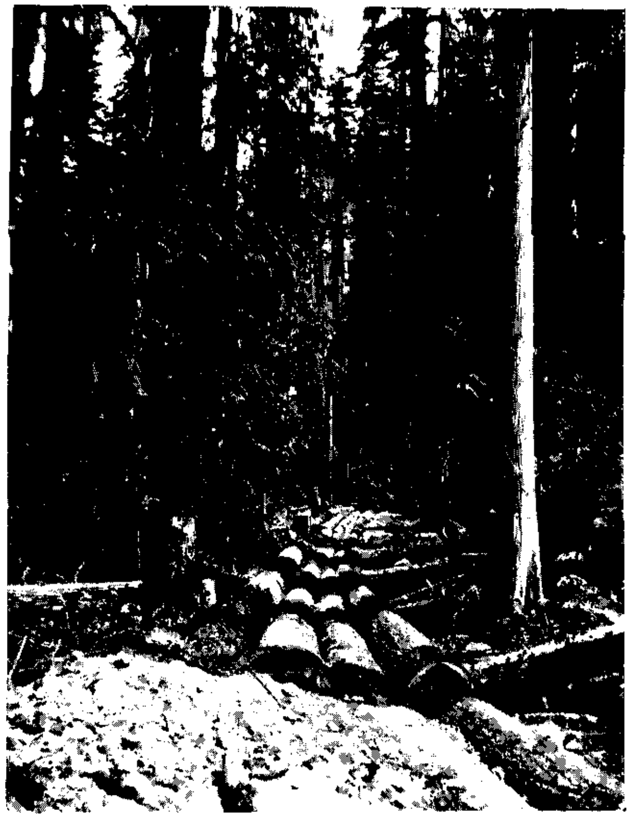
The Long Round to England.

PART II.—THE NEW WORLD.

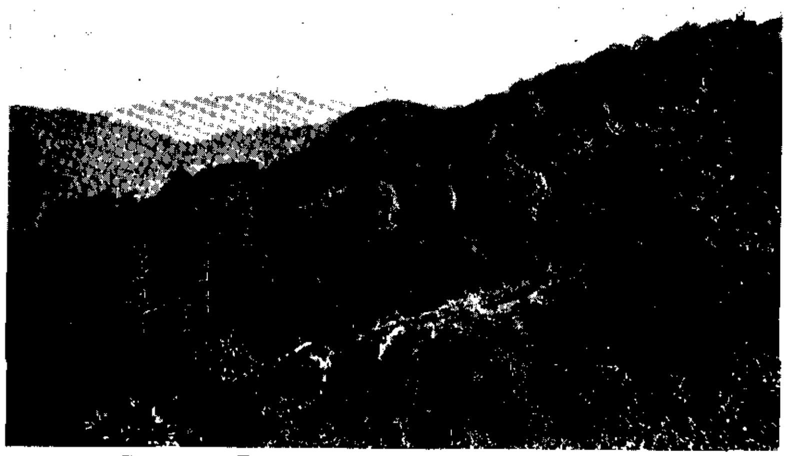
Geographical Position.—The voyage from Colombo to Japan is a coasting voyage along the edge of Far Eastern Asia. It takes about twenty days by the faster vessels. Interesting glimpses of what lies behind on the mainland are obtained by the stoppages at the chief ports, and the traveller's attention is kept as much on the land as on the sea. The passages across the oceans which separate the Old World from the New carry with them a *new* experience. That from Yokohama to San Francisco lasts eighteen days, with one stop at Honolulu, and that from Quebec to Liverpool eight and a half days, of which six clear days are spent at sea. Except close to land we saw less than a dozen vessels in those six and twenty days. The feeling of isolation from the rest of the world and of dependence on one's shipmates, temporary though it is, is very complete, and a deep impression is received of the immensity of the ocean and the boundless wastes of water.

And—to compare big things with small—there can be no doubt that this same influence of the oceans operates in a very real and lasting manner on the history and development of the New World, and of the great new nations which are growing up in it. No one who has not crossed these or other similar great oceans can realise by how much the Old and New Worlds are divided. Individuals may cross with ease, but nations hardly. No greater contrast in civilizations could be obtained than is afforded by the journey across the Pacific—at one end the ancient culture and customs of India and the Chinese, from whom also the Japanese derived their old religion and customs, and at the other the most progressive elements of western civilization, engaged in the race for material wealth in the Far Western States of North America.

Development of North America.—The New World is a new world indeed. Discovered, or re-discovered, four centuries ago, it is only in the last hundred years that great strides have been made in the development of North America. These have all proceeded from the east of that continent. In the case of the United States, the thirteen original states were federated in 1781, almost at the end of the War of Independence. Extending from the Atlantic to the Mississippi River, they comprise less than one-third of the area of this vast confederation. The whole of the remainder, consisting of the boundless prairies, now the wheat-fields and grazing grounds of the West, and of the mountainous region with fertile valleys and the dry belt of the Rockies and the Far West, were acquired by discovery, or bought from or ceded by France, Spain and Mexico in the first half of the nineteenth century. The development of Canada has been on the same lines, but has proceeded more slowly. For one thing the great stream of



A TIMBER ROADWAY.



DECIDUOUS FOREST OF THE APPALACHIAN MOUNTAINS.

emigrants escaping from real or imaginary tyrannies, and at any rate in most cases from very real poverty in the old countries of Europe, naturally turned their eyes towards the great wealthy new country with a new constitution on the most democratic lines, called The Land of the Free, rather than to the new country to the North with the Old World constitution. Secondly, Canada has laboured under the disadvantage of a reputation for an extremely cold climate, as exemplified in the title "Our Lady of the Snows."

Climate and Physical Features.—This pretty name hardly gives a correct idea of the conditions which, as in the United States, are mainly continental with great extremes of heat and cold. The areas of Canada and of the United States (with Alaska) are nearly equal, and each approximately the same as that of Europe. In the case of Canada, it is of course true that arctic conditions prevail over the northern portion of the country, but probably nearly one half, or even more, of the whole area is good *productive* land either for agriculture or forest, and suitable for Europeans. Of the United States, the South-Western States are too hot for the full meed of out-door labour by whites of European extraction, while the negroes are very numerous in them; the South-Eastern States contain a considerable proportion of arid land. Thus the area suited to white out-door labour in the U. S. is not very much larger than that in Canada though the total amount of cultivable land is much greater. The Canadians claim that, owing to a fortunate bend to the north of the Isothermal line, the area in their territories of the middle west, suited for wheat growing, is equal to that south of the boundary line in the United States. Be this as it may, the former is far larger than was formerly supposed, being about seven hundred miles in extreme length from north to south. The above explanation is due to Canada, because the capacity of the country has been greatly under estimated in the past. To repeat,—the climate of N. America, generally speaking, is of the usual continental type. With the short, quick summer season the wheat, even in Ontario, is cut a month earlier than in England. The damp heat of New York in July is unpleasant even to an Anglo-Indian; but certainly this is partly on account of the lack of suitable means of combating it. The rainfall, except in the Middle West and South-Eastem States of the U. S., is sufficient or abundant, the latter particularly on the Pacific Coast, where also the extremes of temperature are less marked. The physical features of the continent are enormous and very striking even to a traveller from such a large-featured country as India, except in the height of the mountain ranges. In crossing from the west to the east the great width of the physical formations, the mountain ranges of the Far West, the prairies and wheat lands of the Middle West, and the flat or undulating ground of the more highly-developed and older states of the east, make the journey a little monotonous, but this same fact undoubtedly makes for the greater wealth of the country and

increases the tendency to conduct agricultural and industrial enterprises on a large scale The natural wealth, then, both of Canada and of the United States is immense, and hardly conceivable by those who have only visited the countries of the eastern hemisphere.

Social and Political State.—Let us consider now very briefly indeed another of the main heads which make up the life of a nation, the social and political state of the people of each country. To an Anglo-Indian no point of the journey is more interesting than the consideration of the Government and its mutual relations with the social state in each of India, Japan, the United States and Canada In the first the comparatively new civilization of Western Europe has been grafted on to the ancient culture of the East by the force of conquering arm, and the ancient tree, strenghtened though it is, shows on itself comparatively little signs of the change in its stubborn constitution. In India the population is almost entirely agricultural, and to hold a bit of land is a universal ambition.

In Japan the population is also mainly on the land, but a people of an older civilization but quicker disposition has recently, with extreme rapidity and by its own agents, led by its upper oligarchic classes, taken for its own so much of Western arts and the latest methods of government as seemed to it desirable. How different is the case with the great North American confederations. The Western European standards of government and of social condition which, as adopted in present-day Japan, mark so great an advance on the former constitution, appear, when brought into consideration in North America, rather dull and slow and antiquated. And yet it is not 150 years since the English colonists of the thirteen states shook off the yoke of the English Crown, while the northern provinces, Canada, mainly peopled with colonists of French extraction, remained loyal to the same. If it is their conservatism* which chiefly caused the latter to remain constant to our Empire, it is certainly due to conservatism and the conservative form of Government, as well as to misapprehensions about the wealth and climate of Canada, that her development has been so slow.

This same conservatism, however, could only keep Canada back so long as the long line of immigrants continues to turn its steps more to the Southern confederation on account of the advantages conferred on them by the more democratic Government with its consequent somewhat smaller distinctions between class and class in social life. With the balance of power between the conservative old inhabitants of Canada and the progressives with the new comers constantly altering now in favour of the latter, that time is coming to an end.

* In many of the villages of the Province of Quebec no English is spoken, and many of the French representatives when they first go into Parliament are unable to speak, as English is the language of the Houses.

Both confederations, then, are being continuously developed, in both the exploitation of their natural resources is the chief aim and object of the people. Both are practically safe from external attack, and external affairs as contrasted with internal affairs appear of remarkably small importance, especially in the U. S., to the vast majority of the population, and no wonder, for even though the U. S. contains already about eighty million inhabitants, there is said to be room, in a country of immense wealth as well as size, for nearly eight times that number. How great, then, may be our expectations for Canada, how little our surprise that they already look forward to the time when they will be able to cherish and protect the mother country as she has in time past cherished and protected them.

Leaving aside the negro question, social conditions in both countries are almost the same. The differences in the national life are thus essentially political.

The separation of the United States from England was due to a display of arbitrary power by the latter. The aim and natural result of success in the War of Independence was the creation of a democracy, the abolition of class Government and the establishment of equal rights for each member of the nation. Under the democracy the federated states are responsible to themselves for their own internal working, and are to that extent self-governing, but matters affecting other states or the country as a whole are dealt with by the Federal Government. This system, in practice as well as in the theory, is eminently suited to the development of a wealthy country of virgin soil which is relatively completely safe from external aggression. The decentralisation of Government and freedom and power to progress of *each individual*, though they have already been the cause of one of the greatest civil wars known in history, have also been the main factors in the unexampled development of the country, and this latter is the direct off-spring of the American character of energy and powers of organization, working under and fostered by the particular conditions named above and by immense natural resources. Character and country have developed mutually, and, we may say, exuberantly, and the tendency of these later years is that wealth, of which there is enough for all, is obtained and kept with difficulty owing to the unscrupulousness and over-keenness of a few to obtain an undue portion. This is the undoing of the ideals of the democracy, and, in addition to being a bad example, because often successful, leads to much bitterness and strife between capital and labour. The more central and permanent Government of Canada, while it makes far slower development, appears to have more ballast, and exercises a better and more lasting effect on the social system.

Canada in its combined political and social state is placed in a curious intermediate position between England and the States; it is a democracy under monarchical influence.

Effect of the above on the Forest question in the United States.—The above very imperfect sketch has been given here so that readers of the *Indian Forester* may understand rather more clearly the conditions and difficulties which have to be faced in the evolution and working out of a forest policy for both the States and Canada. The interest of the journey lies as much in the study of these problems as in the inspection of the very varied sylvicultural conditions in the two countries. The systems of forestry may be, and are, universal, but the methods of introducing a forest policy vary proportionately with the states of society in different countries. The instances of scientific forestry, including the establishment of State forests, being introduced by other forms of Government are numerous, but the writer is probably right in saying that in no other case has the thing been done on a large scale by a republic, except in North America. With the enormous development that has occurred there during the last century, and with seemingly inexhaustible wood supplies, both the boundaries of the forests had to be pushed back by settlers, whose only desire was to get rid of the tree growth, and the rich supplies of timber were most wastefully exploited by those who knew their value and had the means and brains to work them out. With such supplies and under such conditions of Government an enormous waste was inevitable. To those who objected the settlers had a ready and reasonable reply, and lumbermen, who turned the timber into money, had, and still have, the means to stifle discussion and awkward questions. Much of the timber-wealth of both the States and Canada was obliged to be removed to make way for cereals. What proportion of the soil is to be retained under each of these classes of crops in the future is no doubt still unsettled, but the comparatively easy acquirement of great fortunes in the lumber-industry and of the influence which they carry and the serious depletion of timber stocks brought the matter to an acute stage a few years ago.

Forests in the Far Western States and their Treatment.—And here we may turn aside from the abstract discussion to recollect some of the forests we passed through in the Far Western States of California, Oregon and Washington. A short excursion into the country of the Red-wood (*Sequoia sempervirens*) to the Upper Basin National Park south of San Francisco, confirmed the opinions, expressed by knowledgable men interested in the forest question who were met with in that city, that the Sequoia forests, which originally formed a principal part of the forests of California, are being rapidly exhausted. The State and Federal Governments, which have already put their heads together and created several large National Parks and Forest Reserves, are again considering the question with a view to still further large reservations, for with the denudation of the slopes of the Sierra Nevada and Coast ranges, the diminution of the water-supply for irrigation purposes

in the rich Californian valleys, where an artificial supply of water is essential, already gives ample promise of becoming serious. Again, to any forester the railway journey northwards from San Francisco through Portland and onwards east across the Cascade and Rocky Mountains by the Northern Pacific Railway must be of the greatest interest, especially when it is varied by a trip to a lumber camp in full working order. In all the forest seen until the Cascade Range had been crossed, the principal species is or has been Douglas fir (*Pseudotsuga taxifolia*) and the chief accessory species white hemlock (*Tsuga heterophylla*). Red cedar (*Thuja plicata*), spruce and balsam spp, as well as pines. The sugar pine (*P. lambertiana*) was not seen. On the western slopes of the Rockies interesting mixed forests of larch (*L. occidentalis*) and the above mentioned species are seen from the N.P. Railway. These all belong to the *Coast Province of the Pacific Forest District*,* the area with the most luxuriant temperate forest growth on the face of the earth. The almost pure forests of Lodgepole pine (*P. murrayana*) in the Yellowstone Park have less interest owing to their poor quality at the high elevations of 6,000 feet and over. They belong to the *Interior Province of the Pacific Coast District*,* in which the rainfall is slight.

The present value of all these forest areas, from those of the Redwood onwards, must be considered from certain standpoints. All forest land within reach of the railway, and much of that at a distance, has been lumbered over and a great part burnt, not once or twice but often. Thus their climatic value as reservoirs for the rainfall has been in great part destroyed. Similarly their intrinsic commercial value is largely a thing of the past, for over large areas "burns" have been so bad that there is nothing underneath the sparse old stock (half of it dead standing timber) but some scattered young growth with a tangle of bushes. There are, however, other larger areas, even close to the railway track, in which, though the valuable species among the older classes were mostly cut out, enough were left to seed the ground partially or in some areas completely. The forest will have been burnt over at least once or twice since lumbering, to clear the waste material, and since then it has happily escaped conflagration. Needless to say there has been no sylvicultural intention in such firing. The resulting reproduction however is in some cases of the very best quality. Some striking instances of this are seen in crossing the Cascade Range, when beautiful young mixed Douglas fir forest alternates with some terrible burns in which there may be hardly a living stick on a big mountain slope. In the virgin Douglas fir forest, the surface is very damp, and the only reproduction seen is that of hemlock, growing often on dead fallen logs. On the whole, then, while the ruthless methodical destruction

* C. S. Sargent, quoted in W. R. Fisher's translation of Schimper's "Plant Geography."

over large areas is a sad sight for a forester, and indeed for all persons with any economical instinct, there are other large areas which retain their value as commercial assets for the future, and which, if not kept by private owners as forest or converted into agricultural land, are well suited to form part of the State forest reserves.

Again, further from the markets and the main tracks of railway, there still remain large areas of untouched virgin forest. The writer had the good fortune to visit one of the camps of the St. Paul and Tacoma Lumber Company on the lowest slopes of the Cascade Mountains near Mount Rainier. The Company has bought about 80,000 acres, and is one of the largest among twenty-five or thirty others in and round Tacoma, which divide five or six million acres between them. It must be explained, for the benefit of those who are not aware of it, that for the purpose of their development the whole of the Western States were by degrees divided up on the map and on the ground into sections, each of one square mile, and quarter sections of 160 acres. These have been gradually opened to settlement and allotted at a nominal price, but it is understood only one quarter section is allotted to each settler. It is not difficult to get round the intention of the statute, and companies are formed for lumbering with many thousand acres. The company which had the enterprise to build the Northern Pacific Railway from Lake Superior to the Pacific about 25 years ago obtained a free grant of the alternate sections on a width of 80 miles along the line. Thus fortunes may be made. In the case of the particular lumber company cited above, certain of the sections composing the area were bought from the railway company and a considerable portion of the remainder was acquired at 2½ dollars per acre. The land with timber on it is worth about 8 to 10 dollars per acre, but a big sawmill plant must be erected, which has been done in this case at Tacoma, about 25 miles from the forest, and the cost of exploiting the timber to the mill is considerable. We were informed that land at 2½ dollars per acre would give 10,000 to 20,000 board feet sawn timber. The best portion of the evenly stocked forest seen contained a *very large* stand, the trees all of 400 to 500 years old, averaging quite 200 feet in height with diameter growth up to 8 feet. The forest was mainly composed of Douglas fir, and the biggest tree the Superintendent, a Canadian Scotchman, had seen was quite 300 feet long, being 197 feet to the first branch ! With annual cuttings of 2,000 acres to supply the mill, which has a capacity of 150 million board feet annually, the whole area is expected to be cut over in 40 years. After being cut over, the suitable portions are sold for grazing ground or agriculture, the lower slopes will fetch perhaps 5 dollars for grazing, and the bottom lands anything from 10 to 100 dollars per acre according to the accessibility to the towns.

One of the chief reasons why the cut-over lands are sold is the incidence of taxes, which are on the land and not on the

lumber. The imposition of the taxes lies with the authorities in the counties, the county being the sub-division of the State. An unfairly high proportion of the taxes are derived from forest lands, but they form a reliable source of revenue. There are several ways of combating this, which is one of the chief causes why privately held timber lands are given up after being cut over, and which is therefore of the highest importance to the preservation of a sufficient area of forests in the county. This may also be said to be one of the principal reasons for the prevalence of forest fires. When the timber has been cut out in any particular area it is to the advantage of the land-holders that fire should run through and clear off the remaining lumber so that the land may be sold off at the best rates to settlers. The question is a difficult one to settle owing to the large number of counties whose interests are involved, but its settlement would form an important stepping-stone towards the accomplishment of a sound forest policy for the country.

Reservations and Education of the Public.—It is owing to the destruction of the forests, to the waste, the use without foresight of nature's bounties, which seems to be inevitable in human nature when brought face to face with great natural resources, and which has taken place in this case on account of the rush for cash, wealth and the disadvantages of holding on to forest estates—on these accounts the Federal Government, at the instigation of a few, has in the last 12 years stepped in and withdrawn from sale and settlement certain large tracts, all in the mountains of the thinly populated Western States, and constituted them forest reserve. What the intrinsic forest value of these reserves is, the writer cannot say. Much of their area lies at the highest elevations on main watersheds, and they thus form part of the agricultural backbone of the country.

The process of forming the reserves perhaps found its prototype in Indian forest administration. But whereas in India the Government is a law to itself, in a free country before action is taken the case for and against must be made clear to the public. There may then be said to have been three parties in the States, namely, the members of the powerful lumber industry, the few persons interested in the economical use of the forests, and the public. It is probably right to say that the case for forest conservancy made little way until it was properly stated to the public. This was the logical way, and it was done and is being done still largely through the agency of the newspapers. Needless to say, great facilities are also offered to, and accepted especially in the East by lumbermen to induce conservative working, but no Anglo-Indian Forest officer can fail to notice the newspaper-enterprise of the Forestry Bureau, the numerous articles of general or local interest on forest affairs in local papers, or the effect of this crusade on the opinions of the general public as represented by the comments in the newspapers and of casual fellow-travellers by rail or in hotels. Thus the mature general public is

kept informed and educated. What is being done for the young the writer cannot say. It seems, however, certain that if more efforts were made to educate the children of all countries in the economical use of the land and its varied interests, in addition to the social life of rural districts being made more attractive, the dangers and inconveniences would be diminished which are caused by the inrush to the towns and the scarcity of labour on the land, and this applies to forestry also.

The Federal Government having determined on forest reservations, did wisely in making a big thing of it. If they went ahead of public opinion there, they also appealed to the public vanity. Since then, there is no doubt, they have carried the people along with them, so much so that the question of spending a large sum of public money in acquiring a large forest estate in the east in the Appalachian Mountains is favourably commented on, and although there are naturally interests which are opposed to the withdrawing of timber lands from sale and their reservation, lumbermen have by their past treatment of the forests to a great extent spoiled their chances of securing a verdict, while those who already hold such lands are not more sympathetic, as the withdrawal of large areas, and the fact that little or no work is being done by Government, except where essential, as in the Black Hills, South Dakota, has *limited the supply and forced up prices. The administration of* the reserves is not yet in the hands of the Bureau of Forestry. In a country where money is turned over so rapidly as in the States, the creation of forest reserves by the central Government is in any case doubly essential. Few private proprietors can afford to hang on for a second crop at present. This is the case only until the country has filled up and the scale of living becomes normal. At present the cream is being taken off the land, and it may undoubtedly be said that, at least in the case of agriculture, this fact coupled with the characteristic energy of the Americans enables them to compete unduly with producers in the older and less productive countries of Europe.

The present sparseness of the population and the condition to which the forests have been reduced, are factors to the success of the present policy of making large reserves. There is so much land of the required class to spare, lapse of time will, it is to be expected, witness the simultaneous filling up of the country and the growth of the forests into valuable State property. A big start has been made at a fortunate time towards providing for successive generations a sufficient timber supply, at least for the home demand. We are told that the consumption of wood per head per annum in the States is 350 c.ft., of which one quarter is timber, while in England the corresponding figure is only 13 c.ft. With rising prices and a failing supply, for the present at least, the consumption in the Western States, in which, as in Japan, nearly all the houses are built of wood, would seem likely to diminish somewhat rapidly, and given proper measures

of conservative working, Government and private enterprise should be able to cope with the demand for the home market and leave a good deal over for export.

Forests of the Eastern States.—After leaving the Yellowstone Park, we made an interesting side-trip to the Black Hills in South Dakota, a compact reserve of 2,000 square miles of *Pinus ponderosa*, situated mainly on archean and granite formations, its chief purpose being to supply the gold mines with pit props, etc. The reproduction of this pine is very easy. Apart from this reserve, however, the plains of the Middle West, from the Rocky Mountains for two-thirds of the way to the Mississippi at St. Louis, are devoid of tree growth. East of that, as we neared the great rivers, we passed into country which is often much like that of the Indian (B. I.) plains, very flat agricultural land with groves of hard-woods, which have, without exception, been cut over. This is the commencement of the *Summer-green Deciduous Forest of the Atlantic Forest District.** From St. Louis, through the southern parts of the States of Illinois and Indiana and through Kentucky and Tennessee to Asheville in the Appalachian Mountains in North Carolina, we passed through more or less undulating country of wheat and cornlands with numerous small mixed woods of oaks, maples, chestnuts, tulip trees and other species, including pines (*Pechinata*), a striking contrast to the great coniferous woods of the West. This class of hard-wood forest has its best development in the mountains. The writer had the good fortune to visit the Pisgah forest (210 square miles) belonging to Mr. Vanderbilt, in the Appalachian Mountains. Though intersected to some extent with cultivation, often small holdings, in the valleys, the forests on this long chain of mountains present a wonderfully unbroken aspect. From the Mississippi River onwards we are in the original states, and there are no forest reserves as yet. The woods, the remnants of the old forests, have all been cut over long ago, but are still valuable, and the population is still comparatively sparse, while much of the more undulating ground is eminently forest land. The slopes of the Pisgah Mountain forest have also been nearly cutover in the past, but the stock, though now somewhat open and crooked, has the elements, to say the least, of a very valuable forest property. The principal species are Sweet Chestnut (*Castanea vesca*), oaks (*Q. alba*, *Q rubra*, *Q. coccinea*, *Q. tincttoria*), tulip (*Liriodendron tulipifera*) and many other broad-leaved species with hemlock (*Tsuga canadensis*), and at higher elevations Silver Fir and Spruce. Under the conservative but progressive treatment now in vogue on this private property the cores only are being worked, but the coupes are heavily felled over, seed trees of Chestnut, Oaks, Tulip trees, and Locust (*Robinia pseudocacia*) and black Walnut being left. Chestnut wood fibre is now being used for the extraction of tannin. Tulip timber (yellow poplar) is remarkably

* C. S. Sargent.

straight and free from knots, and has the qualities of spruce. On the hill tops are many old pastures. The grazing rates are three dollars for six months. The beauty of the forest is greatly enhanced by the heavy growth in damp localities, where the canopy is open, of the white rhododendron (*R. maximum*) and Kalmia. We are here at the southern extremity of the white pine (*P. strobus*) area, and North and West of, and too much in the mountains for, the three well-known pines of the Southern States. A little way east of the Appalachians, we pass into these *Coniferous Forests of the Atlantic Forest District.*

In these Eastern States there are the mountains of the New York and New England States and the Appalachian or Alleghany Range, which are natural big forest lands. There are also the southern coniferous areas, of which the writer can say nothing. The numerous deciduous woods in the greater part of the remainder are *all private property*, and are of much the seme quality as many in England. The timber of the better class and more valuable species has been mostly culled and the woods are immature and openly stocked, but the young growth and small poles (consisting in North Carolina of pine, tulip, maples, oaks) are promising.

Can such woods be made profitable to private owners and the country at large?

Lumbermen in the east show more inclination to adopt conservative working than those in the west. It is already known to readers of this periodical that the Forestry Bureau has made special efforts to induce private owners to work conservatively and to have working plans made for their forests by the Bureau. *Applications are sent for working plans*, and these are at present made for "the lands most likely to furnish useful examples. A working plan once prepared will not be put in effect unless it is satisfactory to the Division of Forestry and to the owner" (Circular No. 21 of 1898). The applications received have been very numerous and involve a large area, and are quite beyond the capacity of the present staff of the Forest Division. In almost all cases the owner wishes to get larger interest on his capital than can be furnished by forest growth. The average area of the lumberman's annual coupes is too large for the work to carry on until a second crop can be obtained. We have it on the best authority that owners are likely, under systematic working, to prefer to get a larger periodic rather than a smaller annual yield, and that they will keep on the land for the second crop. The question of taxes hinges on this again. In dealing with lumbermen on their own lands Government can only take them by the hand and lead them on slowly. The matter is largely a "business proposition," the rotations will be financial, working plans must be of the simplest kind. To us it seems that Government would do well also to take up areas of sufficient size of the half dozen or so principal species and give a more detailed and scientific (and not less business-like) exposition of the best forest methods with annual coupes. European

methods may seem too conservative to Americans, but even if this view is correct, the happy mean undoubtedly lies far nearer the European than the present American standpoint. Science and conservatism are in this case synonymous, but looking at the interests involved, we cannot expect progress in their direction to be other than slow. To summarise: No doubt the discussion about the correct methods and intensity of treatment is of much importance and will become acute among scientific foresters, otherwise they would hardly be entitled to the name, but to an outsider it appears that the premier work still lies in the maintenance of public interest in the general forest question and in the provision and preservation of a sufficient area of reserves, suitably located, and their protection from damage, especially fire, and the same in the case of private forest property.

A Day with Hounds.

A violent hammering on the door which, so inexplicably during sleep does one's brain work without any expressed authority or conscious exertion of will-power on our part, coincided curiously with the deafening thunder of a terrific storm with which I was battling in my dreams far up in the mighty Himalayas in a manner altogether too realistic to afford one much rest. The thunder crashes became louder and more continuous, finally becoming so violent as to snap the thin thread linking sleep to wakefulness and bring me out of the land of nod. It was but to find that the tempestuous warfare of the elements of my dreams was being repeated with a vengeance in the real world without. From the discordant syren-like whistle of the wind as it tore round the angle of the wing I was occupying, from the crashing of the tall tapering-topped pine trees in a closely adjacent clump, and the sharp pattering of the rain drops driving against the casement, it soon became obvious to my sleep-dulled senses that this was no land of dreams. A three-quarter gale was blowing outside and a devil of a din going on as the result of it. The first feeling of relief that I was snug under the counterpane in an English country mansion, and not up in the wild picturesque but decidedly uncomfortable (in a storm) Himalayas, was rapidly followed by one akin to despair. The remembrance came on me in a flash—was there not to be a meet some eight miles away, and was it not my first for nearly seven long weary years? Surely that fickle flirt the Goddess Fortuna was not, could not be, after carefully bringing one through great stress, and fortune good and ill, all these years to the very morn of the long looked for day—surely she was not going to chuck one over at the last moment. Her sex delight in doing so, one knows, and there was every indication that this was her intention in the present instance. It was still as black as pitch outside, but as one's toilet proceeded a fitful daylight struggled, and struggled almost in vain, with the

tembrean darkness. Of sun or sunrise there was not a vestige. Only the rain-soaked pine trees stood out by degrees less faintly, could be seen a little more distinctly against the stormy, cloud-laden sky. The wind still kept to its wild dirge, the accompaniment of the crashing branches being not untuneful, though rather too mournful for a hunting morning. Was it, is it, good enough one could not help wondering! One's mind conjured up so vividly, too vividly, the prospect before one. The jog, jog along the 8 wet miles of sodden muddy country road in the tempestuous wind and driving rain; the, in all probability, dreary wait for the late hounds, and later Master, the latter of whom would be sure to wait a bit to see if it was going to lift before he set out, the perhaps aimless wandering from covert to covert as blank after blank was drawn, the rain meantime soaking one through, running down inside one's collar and trickling down along one's marrow bone, whilst every tooth chattered as if it wished to play a tune to its own notion of time and without reference to the messages sent to it from the brain along its slender, but at times diabolically sensitive, nerve chord. One's mount meanwhile, as miserable and dejected as oneself, splaying about in the mud like a camel carrying one's best crockery after a Christmas rain shower in Northern India. Such was in all probability the least of the disagreeables to be expected on such a day, and things might prove so much worse. Visions of undesirable resting places in muddy ditches, unlooked for baths in ice cold water, flitted across one's mind as one mechanically finished dressing and went down to the breakfast room. A cheerful fire, which only made the inferno going on outside the drearier; no one else down, and a query elicited the information that they were all in bed. No one else evidently was going to be such a lunatic as to face the elements on such a morning. Gulping down breakfast one swore at fate, at the fickle jade who had brought one to such an impasse. For had not the sunset and sky of the evening before, so anxiously scanned, been full of signs and portents full of promises of a fine hunting morning—at one's boots, which were too tight, cravat which was choking one, and at oneself for being such a fool.

Once out and battling in earnest with the wind and rain one began to forget the discomfort. To be again on the way to a meet! Those who have been out know what it means. Already the blood flows and quickens in its rush through the veins. The eight miles are passed o'er like a dream, and one reaches the Crow and Gate Inn, the rendezvous,—such a picturesque spot one knows it to be in the sweet spring and summer months, but one has to take all that on trust just now. Through the driving rain and mist, the quaint gabled hostelry looms suddenly upon one, the old signboard giving out a weird uncanny sound as it tosses wildly to and fro under the buffetting of the wind. A quaint signpost that with its pictorial representation of a weird, wild-looking feathered creature, purporting to be a crow, perched on a gate, the

dimensions and timbers of which would make the boldest hold his breath whilst he tried to negotiate it, and would not unlikely cause him to hold it for good.

A few shivering forlorn hunters were being led about by heavily cloaked grooms, three men and a girl were leaning against a sheltered wall of the house, and that was all! No hounds! No Master, at present! We joined the men and the girl. No one said anything. What was the good? Things spoke for themselves too plainly.

A quarter of an hour, and then another, passed. A few more people had turned up, several others were sitting cowering beneath waterproofs in traps and other vehicles. A crack of a whip, and at last hounds turn the distant corner of the road, followed by whips and the Master. A move is made by all, and shivering women and men climb into the saddle, the hunters by far too dejected to show off or play pranks, the starch being taken out of even the most vicious kickers, which, existing in every hunt, require marking down and careful watching, for their room is ever to be desired to their company. We move off, a crest-fallen throng of under thirty. One is cogitating as to whether to make up one's mind to stick as close as possible to hounds or to follow one or two of the knowing ones. After such a long absence it is difficult to know what best to do. One has almost made up one's mind to stick to hounds when one of the best, whose place is ever in the fore front, wheels to the left and goes off into the mist. A moment's hesitation, and one follows. Crossing a couple of fields the man in front takes up a position at the corner of the wood to be drawn. If his hopes are fulfilled we shall get a clear lead. We sit sheltered from the wind a little, but with the rain soaking and resoaking through us, and dripping from our boots as from a spout. We hear the hounds at work now and then, but it is difficult to either see or hear under present conditions. Nothing appears, and one begins to get uneasy. My companion, who has been sitting like a Centaur, suddenly gives vent to a deep and earnest malediction and, topping a fence, disappears. One follows, only to realize that hounds have gone away, and one has been too clever! We hurry to the other side and set off in pursuit. My companion raises my hopes, and turning away to the left, informs me that on such a day the fox will probably run left-handed. But ten minutes later his prognostications are verified, and we have that sweetest of all music, the music of hounds in full cry, going across our right front. By keeping straight and hard we get up, and whilst mentally poring out oblations to the fickle one, now fickle no longer, I make up my mind, for the hundredth time in my life, to stick to hounds in future as long as they and my mount will permit of it. We are up, and from forms appearing as shadows now and then out of the mist it seems that most of the field are well in. But it is not for long. We all but run into hounds scattered about

in the vapour clouds. They are at fault! Whilst waiting, the mist and driving rain lighten and a feeble wan ray of sunshine, or what stands for such in England at the present day, makes itself felt rather than seen. It is the commencement of a lull in the storm, and as we move off to the next covert, for hounds have in the end to be lifted, the meteorological conditions assume a fairer aspect, though the clouds still hang lowering on the surrounding hill crests. Two coverts are drawn blank, and as one munches rain-sodden sandwiches one's feelings again sink to zero point. The field has already decreased to half, and but ten of us move off to the Park Woods. The Master tells us he will try there and then take hounds home. The ten of us look at one another and wish we were there already. Even the keenness engendered by an absence of six years is oozing away at such an unlooked for first day, admitted on all sides to be the very worst yet experienced this season, already a record bad one as far as the weather is concerned. We huddle together and wait. Hark, the music is commencing, and before one right well knows what is happening we're off over the sodden plough, hounds making the pace a cracker after an old dog fox. Down a steep hill side we pelt, scramble through a wide brook at the bottom, usually a shallow placid stream, but now taking the horses to the girths, and up a bad hill on the other side. The going is cruel, the almost continuous rain for months on end having reduced the ploughs and grass lands to clayey marshes or marshy bogs, rendering the take-off at every bank and fence as unknown a quantity as the algebraical 'x' of our younger days. Rushing along the crest of the hill hounds swing to the right and, dropping into a long valley, pour into and out of a small covert, being at fault on the far side. What a mercy one mutters as one hears one's steed's labouring breath and feels his shortening stride and flagging energy. What a blessing! A check! It is not for long though. In their eagerness hounds have run out of scent. The Master knows his work, knows his hounds, is well up in his country, and is well versed in the wiles of his slim quarry. Quickly does he get the pack on the line again, and they go streaming away back into the long valley at a hot pace. The horses, bless them, are not one whit less keen than their riders, and the halt, short as it was, has patched up for the moment weakened bellows. Down we go, our mounts sliding down bad parts on their haunches, after the manner of elephants going down a steep bank, to the stream again, here much shallower and wider; through it at a hand gallop, the crossing reminding one of many a stream, swollen and turbid, negotiated on marches in the rainy months in far-away India, and on to the plough on the other side. Friend fox had swung right-handed here, and continued straight up the valley—all heavy plough with a sprinkling of fences, nothing at ordinary times, but real obstacles with the country in its present state. Near the head of the valley

hounds turned to the left again, going diagonally up hill straight for a small covert situated on the other side, but whose near edge just topped the crest. The pace was slackening, the horses nearly done, as we reached the crest—a baker's half dozen of us. One prayed for a check, if but for a few minutes, but on topping the summit all hope of such vanished at once. Master Reynard was evidently too hard pressed on reaching the covert side to have time to look for a friendly shelter within it. The risk was too great, as he knew the chances were all earths would be stopped. From our position one was able to take in at a glance exactly how matters stood. Two-thirds down the slope a blackish spot was creeping along; two fields behind were the foremost hounds straining along in screeming chorus; a field behind them the Master on his great powerful chestnut. Ye gods! what a glorious sight it was! Not a second did one lose. It was now or never to be in at the finish and—well we omitted to remember that man was built with a neck connecting the cranium that carries the brain with his trunk. Whilst we were still three fields away hounds run into their fox, and not a moment too soon. As one sprang from the saddle and loosened the girths friend Pluvius changed from fine drizzly to his former steady downpour. But how different were the conditions now to previously! Then, cold, shivering, sceptical, with the blood running sluggishly through the veins at its normal pace. Now, a rollicking run to our credit, one's pulse beating 20 above normal, which would mean an ice pack at once if one's Indian sawbones got hold of one, and one's blood boiling through one's veins like molten lava running down a hill side. Rain! Yes, it rained in torrents; the clouds came down and quickly shut out the remaining available light of the short winter's day, and as we jogged the fifteen miles back the gale got up again and blew in fury. Cold, wet, tired, covered with mud from crown to heel, we arrived home smiling.

Over the smoking room fire after dinner we answered our morning query—Was it, is it, good enough? It was!

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Pioneers of Indian Forestry.

COLONEL G. F. PEARSON.

Colonel George Falconer Pearson, eldest son of the Rev. George Pearson, Rector of Castle Camps Camly, was born at Chester in November 1826, and educated at the old Charterhouse in London under Dr. Saunders. In January 1846 he went out to India as a cadet on the Madras establishment, his commission having been given him by the late Sir James Weir Hogg, the *Deputy Chairman of the Honourable East India Company.*

Arriving in India at the end of May 1846, he found himself posted to the 33rd Regiment, Madras N. I., then stationed at Janbuat in the Hyderabad territory, and joined it there shortly after. Here he soon learned his regimental work, and having passed the Higher Standard in Hindustani at the end of 1848 he was appointed A. D. C. to Sir Herbert Maddoch, then Deputy Governor of Bengal at Calcutta, but on that gentleman going Home in the year following, he reverted to regimental duty, and was almost immediately after appointed to the Adjutancy of his regiment.

This post he held for more than five years, interrupted only by a six months' shooting trip to the Himalayas, one month of which was spent in Tibet. In 1854 when at Nagode in Bundelkhund with his regiment he made the acquaintance of Colonel S. A. E. Ludlow, R. E., the Chief Engineer of those Provinces, and at his recommendation he was transferred to the Public Works Department as an Executive Engineer, and in that capacity he constructed the road from Nagode by Kalinjhur to Banda, for which work he received the thanks of the Supreme Government. This road afterwards in the Mutiny proved of great service, as it was the only one west of the Mirzapore and Jubbulpore Road by which artillery and wheeled carriages could cross with facility the high range of ghats which *separate the high plateau* of Bundelkhund from the valleys of the Ganges and the Jumna. Early in 1856 he was sent to Jubbulpore to lay out the road from that station to Mundla, and on the completion of that work he proceeded Home on long leave.

In the following year of 1857 the Mutiny broke out, and Colonel Pearson was at once ordered back, and rejoined his

Colonel G. F. Pearson.

regiment at Jubbulpore, where it had been moved on the Mutiny of the 53rd Regiment Bengal N. I., and where it formed the nucleus of what was known as the Saugor and Nerbudda Field Force, which afterwards formed a Brigade of Whitlock's Division. With it he took part in most of the operations that were undertaken in that part of the country, also in the action at Patun, and in the "drives" that were made through the Damoh jungles to turn the rebels away from the line of the Nerbudda River, and to force them northwards. But in February 1858 the 3rd Regiment of Nagpur Infantry mutinied at Raipur and murdered their Sergeant-Major, when the 33rd Regiment, M. N. I., were detached from Whitlock's Division with a battery of artillery and were marched direct through Mundla by the *Rajahdhar Ghat* to Raipur. In this march Colonel Pearson's local knowledge came in very useful. The mutineers, however, had decamped before the arrival of the force at Raipur, and after remaining there about a month the regiment returned to Kamptee for garrison duty.

Just at this time a number of irregular corps, called Military Police, were being raised in Central India to clear the country of the rebels. Each corps consisted of a squadron of cavalry and four companies of infantry, about 600 men in all, with a Commandant and Adjutant, and a Quartermaster. Colonel Pearson was appointed to the command of one these corps, the headquarters of which were at Seoni Taking with him a nucleus of drill instructors and men from his own regiment, and from the 2nd Hyderabad Cavalry, which formed part of the force to which his regiment had been attached on service, in about three months he had ready a thoroughly efficient body of men for the work they had to do. It was now that his first acquaintance with forest work began. Mr. Arthur Cocks, of the B. C. Service, who had greatly distinguished himself in the Mutiny in Upper India, was then Commissioner of the Saugor and Nerbudda Territories, and under his orders it was Colonel Pearson's duty to patrol the great forest tract which covers the upper part of the Nerbudda Valley and the upland plateau which now constitutes the Mundla, Seoni and Balaghat districts as well as part of Bhandara.

Now, as soon as the Mutiny was suppressed, this forest tract literally swarmed with timber dealers and contractors, both European and Native, in quest of timber for sleepers and railway works which the Government had vigorously taken in hand. Armed with parwanas, or orders from the civil authorities, it was easy for them in a country where every Gond carried an axe to strew the jungle with fallen trees, while no attempt was made to collect or store them; in fact in most cases it was impossible to do so, with the result that when the forest fires set in, the greater part of the fallen logs were either entirely or partially burnt and destroyed. This was continually brought to notice in his reports,

and this no doubt paved the way to the formation of a department whose duty it would be to preserve the forests from ruin. In August 1860 Colonel Pearson was appointed the first Conservator of Forests in the Saugor and Nerbudda Territory Two years later the Central Provinces were formed into a Chief Commissionership by the addition of the Province of Nagpore, which was added to his charge; and in 1865 the forests of the Assigned Districts of the Berars were also placed under him, so that from 1860 to 1868, when he was transferred to the North-West, his time was entirely employed (with the exception of two short absences at Home) in organising and establishing a regular system of forest conservancy in these Provinces. This work consisted in—

1. Exploration and rough surveys of the forests.
2. Demarcation of reserves and of the forests assigned to villages.
3. Fire protection.
4. Collection and sale of timber, and the gradual development of revenue from minor forest produce.
5. Forest legislation.

It is not the place here to discuss the details of this work, which are well described in Mr. Ribbentrop's excellent work on Indian Forestry. But it would not be right to omit the names of those, some in high administrative positions and others as workers in the forest, without whose assistance the work of forest conservancy could not have been carried on. After Sir Dietrich Brandis, the Inspector-General, whose sound practical advice and guidance was always available to his subordinates, and kept the work going on sound lines, must be cited first the name of the late Sir Richard Temple. There was no more staunch and whole-hearted supporter of sound forest conservancy than he was, not only in the Central Provinces but also in Bombay and in other parts of India, and with his name must be coupled that of Sir Charles Elliott, afterwards Lieutenant-Governor of Bengal, but then Settlement Officer in Raipur and Hoshangabad. It was due to his broad views and sound judgment that the thorny questions which attended the demarcation both of the reserves and the village allotments of forest were settled on a broad and liberal basis in those important forest districts in such a manner that the wants of the people in wood and grazing were amply provided for, while the rights of the Government were amply safeguarded; and what was done in these districts was a useful and practical guide to similar arrangements that had to be made elsewhere. Of those who worked in the forests as Colonel Pearson's assistants Captain Forsyth stands as one of the first, not only on account of his most valuable exploration work, but also that after he left the Forest Department to become Deputy Commissioner and Settlement Officer in Nimar, he (so to speak) invented and worked out the system of revenue from minor forest produce which has since done so much to help the financial side

of the Department. Doveton and Douglas were both sound pioneers in the work of fire protection, in which they did invaluable service, and Brereton by his service in mapping the valuable teak forests in Aheree deserves to be remembered in the same category.

During this period Colonel Pearson did a considerable amount of miscellaneous work for Sir Richard Temple, in addition to his regular forest work, among which may be cited the repair of the bunds of the irrigation tanks in South Bhandara and the collection of local information that Sir Richard Temple then required for the alignment of a direct railway from Nagpore to Calcutta through Raipur. Sir Richard Temple submitted to Government an exhaustive report on this railway, and though it was shelved for some years, this project has long since been carried to completion. It is to be presumed that this report was found useful to the engineers who built the line, as the general alignment was almost exactly followed even to the crossing of the principal rivers and hill ranges.

In 1868 Colonel Pearson was transferred to the North-West Provinces as Conservator. In these Provinces preliminary steps had already been taken to assert control over the forests by giving the local civil officers charge over them; more especially in Kumaon and Gurhwal, and also in the Terai, where the forests had been placed under Sir Henry Ramsay, the Commissioner, and who had taken definite and effective steps for their management. The Dhoon and upper Ganges Valley had been placed under the Commissioner of Meerut, but here, from want of supervision, a good deal of money had been wasted without much practical result. In Jhansi and Gorakhpore very little had been done. There was then a great deal of work spread over a large tract of country to be got through, and the next two years were very heavy years of work, both of an administrative nature, and necessitating much heavy physical exertion with long marches and forest explorations both in the hills and in the plains.

First regular forest conservancy was started in the Dhoon under Doctor (now Sir George) King, who proved a most able forest officer full of indefatigable zeal. On his removal to the Botanical Garden at Calcutta, where his great work in India has been done, Mr. Brereton was brought up from the Central Provinces to succeed him. In the Ganges Valley the road which had been commenced by Mr. Williams was completed up to the Gungootree Forest by Mr. O'Callaghan, with a series of excellent wire rope bridges all the way, including one over the Neeling Ganga, 400 feet above the bed of that river.

Sleeper works on a very large scale were also commenced in these forests, turning out some 400,000 sleepers annually, while arrangements were made for catching the sleepers in the river below Hurdwar. Then the forests of the Upper Tonse and Pabar were thoroughly explored and sleeper works established

there also on an equally large scale as in the Ganges forests, Captains Lillingston and Greig being placed in charge, assisted by the first trained forest officers from Nancy, Messrs. Heinman, Moir and Pengelly. Under their supervision the first water slides and sledge roads were built in these forests, without which it is not too much to say these forests could never have been worked. Two thousand sawyers were constantly at work here, chiefly Sikhs from the Punjab, and the outturn of sleepers was about half a million a year. On one occasion Colonel Pearson crossed the high pass below Bunderponch direct from the Ganges into the Upper Tonse forests in the Herby Dhoon, which is nearly 19,000 feet elevation, saving a march round of twelve days. Besides this regular conservancy was started in Gorakhpore and Jhansi under responsible officers.

At the end of 1870 Sir Dietrich Brandis, the Inspector-General, returned to Europe, and Colonel Pearson was appointed to officiate for him during his absence. He continued to act in this capacity till he returned himself to Europe on furlough at the end of 1872. As the Government of India was at this time much occupied with pushing on the railways in the Punjab, as well as in completing the direct communication between Bombay and Upper India through Rajputana, much of his attention had to be directed to sleeper works, which continued to be pushed on with vigour in the Ganges and Tonse, and were extended to the upper Beas Valley in Kulu, and to Chumba. Arrangements were also made for extending the plantation work at Chunga Munga in the Punjab, and attention was paid to Bengal, where the forests had suffered much from bad and inefficient management, and Dr. Schlich was brought from Sind and appointed Conservator there. Moreover, a separate department for forest surveys and the supervision of working plans was started under Colonel Bailey, R.E., at Debra, where since then the Forest School has been established. At the end of 1872 Colonel Pearson went Home, receiving the thanks of the Supreme Government for his services while officiating as Inspector-General.

Almost immediately after his return to England Colonel Pearson was deputed on the recommendation of Sir Dietrich Brandis to proceed to the continent and to visit the young men under training for the forest service in France and Germany, being officially attached, with the permission of the French Government, to the Forest School at Nancy, which was then under the direction of Monsieur Nauguette. Shortly afterwards he was definitely attached to the school for the supervision of the English pupils, who were all brought to Nancy so as to be under him more directly, and he remained there in this capacity till May 1884, or about eleven years, during which time sixty-three young men drawn from nearly all the public schools in the country passed through the Nancy School into the Forest Service in India. Most of these are now holding high positions in the Service.

Besides exercising general supervision of the pupils, Colonel Pearson attended all examinations and accompanied the pupils on their forest tours with the professors.

In 1876 Colonel Pearson retired from the Army on the pension of his rank, but was continued in his appointment at Nancy as before. In 1878 in addition to his duties at the Forest School, he was appointed as a Commissioner at the Paris Exhibition of that year, the whole of the raw produce of the British Colonies being placed in his charge, besides the large Indian Forest collection. For this duty he received the thanks of H. R. H. the Prince of Wales, who was at the head of the British Section.

In all Colonel Pearson was at Nancy from 1873 to 1884, or about eleven years; and it is right here to acknowledge the great kindness and support which he received from all the School authorities, especially from Monsieur Nauguette, the Director, and Monsieur Putors, who succeeded him in that post, as well as from Monsieur Broillard, who for many years had special charge of the English pupils in their preliminary course of instruction.

In 1884 Colonel Pearson was offered the post of Working Partner in the firm of Messrs. Davies Banks & Co. (the Kington and Radnorshire Bank) at Kington in Herefordshire, and in consequence gave up his post at Nancy to take it up, being succeeded there by Colonel Bailey, R. E. He then came to live at Daunton in Radnorshire, about six miles from Kington, riding in practically every morning to his work, and leading the ordinary life of a country gentleman. But his connection with the Forest Service did not cease here, for on the reorganisation of the Board of Visitors at Coopers Hill, he was made a Visitor of the College on behalf of the Forests. This post he only vacated at the end of 1902, so that from first to last his official connection with the Forest Department extended over more than 42 years.

In 1896, after twelve years' residence at Daunton, finding the rides to Kington in all weathers in the rough climate of the Welsh Hills somewhat more than he could manage without suffering from it, he purchased a small property close to Kington, where he now lives more conveniently for his work at the Bank.

Colonel Pearson has the Mutiny medal, also two decorations from the French Government. He is a J. P. for Radnorshire, and for several years served on the Standing Local Committee of that county. He was twice married, first in 1864 to Caroline, daughter of the Hon'ble A. Erskine, who died in the following year, leaving him with one daughter, and secondly to Emma, daughter of Mr. John Colvin, Lieutenant-Governor of the North-West Provinces, who died in the Fort of Agra in 1857 during the Mutiny. She died at Nancy in 1877, leaving him three sons, one of whom is a Lieutenant in the Navy, and another is in the Forest Service in India.

The Use and Abuse of Forest Work in Siam.

The title I take the liberty to give this little article is borrowed from that in the February number of the *Indian Forester* entitled "The Use and Abuse of Forest Work in Burmah" as it struck me that a few notes on the forest administration in Siam might interest your readers, and might perhaps help to explain the rather stringent remark made by Mr. Gamble in his article on "Certain Important Forest Questions" in the November number of the *Indian Forester*, that in Burmah forest conservation and sylviculture are subordinated to revenue-making.

The first fact to notice is that Siam as regards her forest conservancy is in the position that Burmah was 20 years ago. As Mr. Gamble's personal experience of Burmah dates even further back than that his remarks regarding Burmah would, I think, be more applicable to Siam now, as I presume his thoughts wandered to the Burmah of his time more than the Burmah of to-day. True, I am myself unacquainted with Burmah, but a three years' experience of Siam makes me feel that his remark is by no means inapplicable to Siam. The comparison may therefore prove interesting.

Let us take then Mr. Gamble's point that "forest conservation and sylviculture are subordinated to revenue-making." "Burman" starts out to prove that there is no justification for this opinion as regards Burmah. Here in Siam I regret that there is ample justification for the statement, but on looking into the matter carefully I think a great many extenuating circumstances will be found.

I will now proceed to enumerate the chief points of forest administration in Siam, and at the same time draw attention to the extenuating circumstances.

Firstly then the graded list of Forests Officers consists of 24 officers, of whom 15 are European and 9 Siamese. Of the Europeans only five have had any forest training at all, while of the Siamese five have been trained, one at Coopers Hill and four at Dehra Dun. It may also be noted that with the exception of the three officers lent by the Indian Government, and therefore not permanent, the untrained officers occupy for the most part higher posts than the trained ones.

The above is practically the whole of the forest staff, as although a subordinate staff has been sanctioned very few posts are occupied owing, chiefly, to the difficulty in getting Siamese to undertake arduous outdoor work.

The 24 officers above mentioned have therefore to superintend the whole of the enormous forests which exist in Siam—an area of quite 100,000 square miles. On the face of it the task is of course an impossible one, with the result that so far attention has only been turned to the teak-producing areas which are confined to that part of Siam, north of the 16th parallel of N. latitude.

It is not to be supposed that this is the ultimate aim of the Government, for it is hoped that in the no very distant future a sufficient number of Forest Officers will be enrolled to enable the enormous tracts of forest in Lower Siam, and the Malay Peninsular Provinces in particular, to be taken in hand. At present there is no restriction on the felling of woods other than teak, with the result that at this moment more than one timber firm is carrying on a profitable trade in furniture woods from these Provinces without let or hindrance. Even with this restriction of the area to be supervised the divisions are of enormous dimensions, extending in some cases to the whole of a province.

It is obvious then that with no subordinate staff the supervision of such areas must be very superficial. The Forest officer must therefore make up his mind what matters are to be considered of importance, and what may be neglected, for to carry out all that would be necessary under a strict régime of conservancy is quite impossible. In most cases his mind is made up for him, and he is told to concentrate his attention on revenue-collecting, and, to put it shortly, the Forest officer in Siam is at present, and still will be for some time, much more of a revenue collector than a forester.

It must be remembered, and perhaps I should have mentioned this before, that the Department has only been in existence eight years, and, considering all things, has advanced wonderfully since its organization by Mr. Slade, now Conservator in Burmah, and whose services to the Siamese Government cannot be over-rated.

To explain what this revenue collecting means it is necessary to describe first the system on which the forests are worked.

At the time when the Department was first started the teak areas were being worked either by leases granted from Bangkok, or without leases, for there was no supervision of the work, and it only depended on the good will of the local officials to allow or disallow the working of teak in any district. A royalty was paid on each log, and no log was supposed to leave the forest until it had been stamped with the royalty hammer and had paid the royalty due. This rule was however seldom adhered to, and more often than not the royalty hammer was put up for auction by the official responsible for its use, the highest bidder then obtaining sole use of the hammer for a fixed period. This saved the official a lot of trouble, and was a lucrative business usually to the successful bidder.

Beyond this there were no restrictions; girdling was permitted everywhere, and there was no limit to the size of the tree that might be girdled. Most of the forests were then in the hands of Siamese traders, but about this time several European firms, notably Messrs. The Bombay-Burmah Trading Corporation, began to interest themselves in the Siamese timber trade, and bought up rights in teak forests all over the country. As the original owners in some cases sold the same rights to more than one firm matters soon became rather complicated.

The problems that confronted the Forest Department therefore at the outset may be enumerated as follows:—

1. To dispose of the various claims to the different forests.

2. To restrict girdling, and above all to put a limit to the size of the tree to be girdled.

3. To regulate the collection of revenue on timber when extracted.

4. To arrange for the disposal of the thousands of logs lying all over the country, both in the forests and in course of extraction, which through lax methods had not yet paid royalty.

5. To see that the new rules brought in by Royal Decree were carried out.

It is obvious that with such work before the Department and with a staff of officers at the outset not one-half in number of the present staff there was not much time to be given to such things as the selection and demarcation of reserves, fire protection and cultural operations. It must be remembered that all the work above referred to, which is either directly or indirectly connected with revenue collecting, had to be done entirely by the handful of officers appointed; there were no subordinates to assist in carrying out the work.

For the first four years it may be said the Department were engaged in the foregoing work. Claims were gradually settled, arrangements were made by which all the firms gave up their girdling right, though this did not take place until 1901, by which time enormous quantities of trees had been girdled over every leased area to ensure large stocks to work in the future.

New forms of lease were introduced, the principle of which was that each leased area should be divided into an open and a closed area usually of equal extent, that only the open area should be worked during the term of the lease, that no fresh girdling should be allowed during the term of the lease except with the express sanction of the Conservator of Forests, and then only if it should prove impossible otherwise to work up to the possibility of the forest. Further, if girdling was permitted it was to be carried out under the supervision of a Forest officer, and a limit of 9 kam ($38\frac{1}{4}''$) in demigirth has been fixed as the smallest tree to be girdled.

The restriction of girdling and felling teak except under a lease ratified by Government, with all the conditions that appertain thereto, soon put a stop to a thriving trade in teak posts which was fast ruining the teak forests. The houses in Bangkok, all along the river and klongs (canals) which intersect the country in every direction, are all built on posts, and for this purpose it had been the custom to invariably use teak. In this way some 80,000 teak poles used to be consumed annually in Bangkok alone. The drain on the forests may well be imagined.

To regulate the collection of revenue a timber revenue station was opened at Paknampo, the point about 200 miles above

Mapping out of forests and checking the marking of logs in eased areas by lessees, as according to the hammer used royalty is afterwards paid at Paknampo and Kado, are now the principal duties of Divisional Officers. But this ends it at any rate for the present.

I think I have said enough now to show how the Forest Department in Siam is hampered by the difficulties it has had to contend with, and with its dearth of officers has from very force of circumstances been compelled to turn most of its attention to revenue-collecting.

At the same time I hope I have made it clear that the present work is but the stepping stone to real forest conservancy, in which it is expected that demarcation, fire protection, cultural operations, etc., will each receive its due attention.

Although even now it is to be feared that more timber is extracted annually than the forest can well stand, very great limitations have been put on the work, and the state of affairs is enormously improved to what it was before 1896' when the teak forests were fast on the road to utter demolition.

PAKNAMPO, SIAM: D. O. WITT,
9th April 1904. *Deputy Conservator of Forests.*

Effect of Thinnings on the Growth of Coppice Shoots.

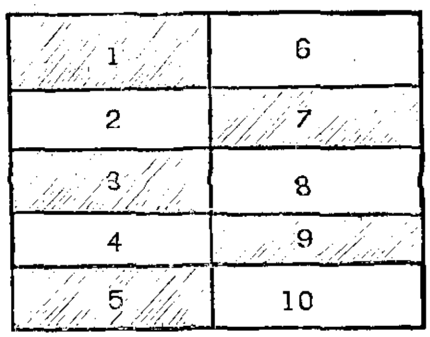
The following is a free translation of an article on the above subject in the *Revue des Eaux et Forets* for September 1903. There are considerable areas in India being worked as coppice (with or without standards) for the production of fuel and small timber. For example, in the Oudh Circle alone fully a quarter of the total area under sal is thus managed. It is therefore possible that a series of experiments carried out on the lines detailed below would yield very valuable results in a very few years' time:—

"The treatment of coppice is still the system most developed in France and of most moment in many estates. Unfortunately their yield is not so remunerative as formerly because of the considerable fall in the price obtained for small firewood, which has practically become unsaleable. It would therefore be a good thing to try and reduce the proportion of such small wood by increasing that of cord wood, as the average price of the latter has not fallen to the same extent. To arrive at this end, two methods present themselves, and might be continued: (1) the lengthening of the rotation, and (2) thinnings.

"Recent experiments have shown that in 20-year old coppice, by cutting out the weakened shoots, those left on the ground acquire, in the course of a few years, much greater dimensions in girth and height than those of similar coppice left

untouched; that in consequence the former yield more billet and less faggot wood than the latter. Various observations point to the conclusion that the differences would have been still greater if the thinnings had been done earlier.

"To solve the above problem the Agricultural Society of France at their last general session decided to institute a series of experiments on the following lines:—



"In a coppice forest as homogeneous as possible both as regard light and density, mark off a sample area more or less square and divide it into two halves A and B by a central line, and divide these halves into four or five fairly equal plots by lines at right angles to the central line. Have thinnings in plots 1, 3, 5, 7 and 9, leaving plots 2, 4, 6, and 8 for purposes of comparison *In this way ample compensation should be provided* for slight differences in light and stocking. Take care and operate only on the coppice shoots, and not to cut out any of the undergrowth. Calculate the volume and value of the contents of each plot, both of the stuff removed and of that left on the ground, keeping a note of the cost of the operation.

"This done, for the purpose of comparison of the actual rate of growth of the shoots in each plot (both thinned and unthinned), choose a number of stumps fairly equal, taken two and two, in the size and number of their shoots. Paint rings round the shoots at $1\frac{1}{2}$ metres from the ground, red, say, in the thinned plots and blue in the unthinned ones. Measure the girths at these rings with a steel tape graduated to millimetres, *and estimate for each stump the volume and value* both of the shoots left standing as well as of those removed.

"Five years later, make a fresh inventory of the yield (in money and material) of each plot as a whole, and also of the ringed shoots in them. Measure the girths of the latter, and, by cutting down a certain number of them, ascertain whether the height growth of these in the thinned plots is greater or not than of those in the unthinned plots."

14th April 1904. X. Y. Z.

Fire Protection and the use of Drums as Fire Alarms.

In the April 1904 number of the "Indian Forester" under the review of the Burma Forest Administration is quoted a note on fire protection by Mr. Slade. He gives it as his opinion that fires under certain circumstances step in to help the forester in producing certain conditions in the forests which improve the chances of teak reproduction, and favour this valuable light demanding species by reducing the chances of less valuable forest growth in the struggle for existence.

Mr. Slade appears to be not the only Burman forester who holds these views.

At first, the idea that fires are beneficial to forests comes as rather a shock to men who have only served in such very dry districts as the Deccan and Guzurath, and who have been brought up to the idea that fires in any case are one of the worst evils that can befall their forests.

"An Old Protectionist," writing in the same number of the "Indian Forester," points out the difference of the conditions under which teak grows in Lower Burma and in Guzurath.

We may therefore still be right in holding the opinion that though fires are beneficial to teak in certain regeneration areas of Burma, they have, on the other hand, the most damaging effect on both the prospects of natural reproduction and after-growth of teak in dry-zone forests. To my knowledge no trained officer has as yet challenged the theory that fires do harm in the dry parts of the Bombay Presidency, so taking it for granted that for the good of the forests fires have to be kept down in these areas, it remains to devise the best methods for doing so, and a few words on the methods adopted in the Panch Mahals may prove interesting to other Forest officers. Specially protected areas, well fire-traced and divided into *sufficiently small* fire compartments, with fire watchers, have been introduced in this division. Such precautions reduce the extent of any one fire to certain limits. To check the number of fires the villagers have from time to time had their privileges suspended. These are all good measures, and I fancy are used in nearly all districts.

A former Divisional Forest Officer when in charge of this district, however, found that in spite of fire tracing and fire watches the areas burnt were often large, owing chiefly to delay in assistance being procured from the villagers. In order to overcome this difficulty he introduced a system of collecting the villagers by beat of drum. The system consists in providing each fire post and each large village in the vicinity of forests with a kettle drum. The fire guard or village headman who is in charge of a drum has to beat it when he sees a fire near or in jungle. The fire guard at once proceeds to the scene of fire, and there beats a quick tatto on his drum, on hearing which or seeing smoke rising, the village drum is beat at slower intervals to collect the people. As the huts of the villages in these parts are often far apart, the beating of the drum not only gives the alarm but collects all the villagers at once to the patel's house, and they then proceed in the direction of the smoke or sound of the fire guards' drum. The fire guards keep up the drumming after the people have begun to collect to call stragglers all to one place.

This method of giving the alarm and collecting assistance by beat of drum has much to recommend it. The sound of these large kettle drums can be heard a long way off, so that the usual excuse so often given by villagers that they did not know of the fire is

overcome. It also has the advantage of collecting the *whole force to* one place, and so facilitates the concentration of all the available energy to the most dangerous parts, an important factor in the success of the operations. The order that the fire guards should continue drumming when most of the people are collected might seem waste of energy, which might be directed in a more profitable way. However, as most officers who have seen fires must know, the moment to attack a fire and beat it out is when there is a lull in the wind, and before this moment has arrived the people are generally standing away from the line of fire, having been driven back by the flames. The general practice in this division is for the fire guard to give the word when he thinks the fire is low enough to be attacked, and with a yell he beats his drum and urges the people on to fresh efforts. This may sound rather sensational, but over and over again have I seen the people urged on to a sudden rush, with combined effort, and final success by giving them the order by beat of drum, when stimulation by word of mouth would not be heard and have little effect. I am unaware if this system of drums is in force in other districts except Surat and the Mahals ; if not, it might be considered by other officers, and I feel sure they will find it a success.

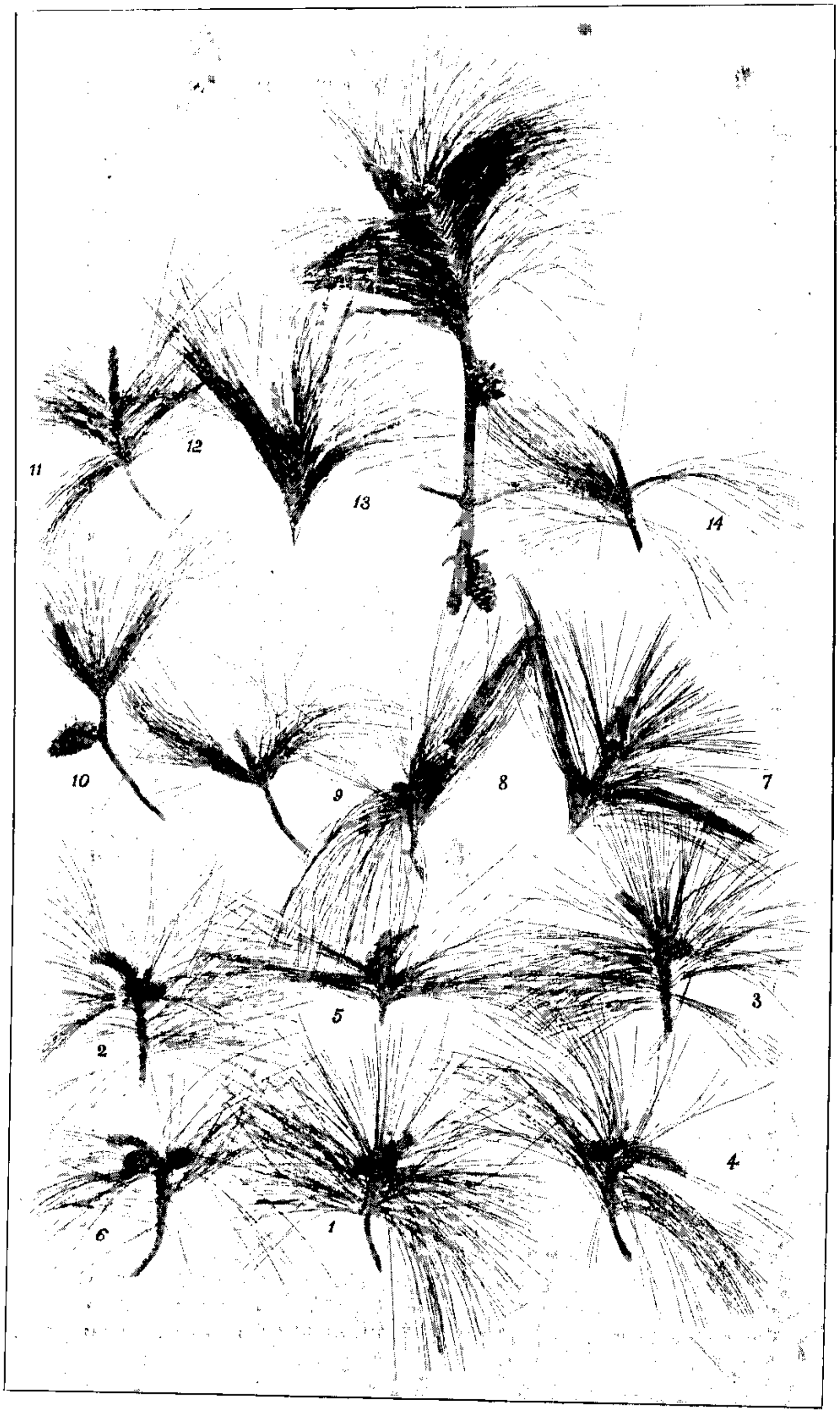
Before leaving the subject of fire protection, I would venture to draw the attention of my brother officers to a book on the subject called "Incendies en Forets" by A Jaacquot, Inspecteur des Eaux & Forets, published by Berger-Leorault & Cie, 18 Rue des Glacis, Nancy, France. I do not know the author, but his treatise contains much of interest in it for Forest officers which would apply to India as well as to France.

RALPH S. PEARSON, I. F. S.

The Ripening of Cones of Pinus Longifolia.

I should feel much obliged if you would kindly allow me a little space in the "Indian Forester" for the following note on the "Ripening of Cones of *Pinus Longifolia*," which is based on actual experiments carried out by myself.

At the beginning of July 1902 I had commenced to make observations on the ripening of the cones of chir pine, so as to enable me to reply in more detail to an article published by Mr. E. M. Coventry in the July number of the "Indian Forester," page 276; although I wrote on the same subject in September 1903, I was then not able to express myself clearly since the article above alluded to was written on some observations made many years ago. I am now, however, able to illustrate my argument practically by the aid of photographs taken, representing the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various stages in the development of the cones. Figure 13 shows the cones formed year before last, *i. e.* (1902, 1903 and 1904). Similarily figures 1, 2 and 3 illustrate the fertilized cones; lately formed, coming out from among the male catkins. Figures 4 and 6 show *the fertilized cones, about 15 days old, with the* male catkins falling off.

This is practically a further development of that shown in figures 1, 2 and 3. Figures 11 and 14 illustrate the small unfertilized cones of this year on the tip of the flowering stalk. Figure 12 shows one large fertilized and two small unfertilized cones of this year. Figures 8 and 9 show clearly the intimate result of these small unfertilized cones of last year which were originally formed on the tip of the flowering stalk. Figure 7 shows the same unfertilized cones of the year before last. Figure 10 represents a branch which was taken off from the tree in September 1903, and shows one unfertilized cone of March 1903, and the other large fertilized cone of March 1902.

Figures 1, 2 and 3 fully illustrate that the male and female flowers appear on the same shoot. The female flowers at the base of the flowering stalk are only fertilized, and the growth of the cones after fertilization is so extremely rapid that it would seem almost impossible to believe that the cones shown in figures 1, 2 and 3 are about a week old and $1\frac{1}{2}$ inches long, while those in figures 4 and 6 are only about 15 days old and 2 inches long, that is to say, the growth in the one case is $\frac{1}{2}$ inch more than that of the other during a period of 7 days.

Figure 13 shows that the distance between the cones produced each year is 14 inches; the question is then how is it possible that the cones on the top of the flowering shoot and *those at the base of the some flowering* shoot, a distance of $4\frac{1}{2}$ inches, are formed in two different years. That is the cone at the base fertilized this year and the two cones on the top will be fertilized next year, which seems to me impossible.

Figure 8 also shows that there are some leaves between the cones of last year and the flowering shoot of this year, and hence separating the cones of the two years.

I will also add that the female cones require a large quantity of pollen to fertilize the numerons ovules, and therefore the cones at the base of the flowering shoot are readily fertilized, while, on the other hand, those on the tip of the flowering shoot cannot get fertilized owing to not receiving sufficient pollen. The male catkins being *situated below them*, and when the pollen is shed it naturally falls to the ground, and the pollen from other flowers is so distant that it becomes impossible for them to receive the required large quantity. I have not observed any insects on the flowers that might possibly cause fertilization, and the resinous matters exuding from the cones is so very sticky that any insect coming in contact with them would probably get caught for good.

Now suppose if cones are produced this year and are fertilized next year by new catkins, the distance between the two, as already explained, would be about 14 inches (see figure 13), which is to my mind too far to allow of proper fertilization. On the other hand, in case they be fertilized in the same year as they are produced, there is no reason why they should turn hard and brown the first year, and again green and soft the following year and continue to grow, reaching in a month or so to their full size. It is generally a rule that if any fruit is formed it grows regularly to its full size without any intermediate obstruction such as would happen in this case.

Since July 1903 I have observed that many of the small cones which were green on the shoots have fallen, while others which still remained on the shoot have now turned black, brown or red, and have not under any circumstances been transformed into green living cones and become fertilized as was supposed, *vide* figures 7, 8 and 9.

Observing again in February 1904, it was found that all the shoots of *Pinus longifolia* had a terminal bud which expanded and produced either male catkins or else both male and female flowers on the same flowering stalk as is seen in figures 1, 2 and 3, where there are the fertilized cones at the base of the flowering stalk, and consequently the growth of the shoot is not checked, and it continues to grow, producing needles on the new shoot. On the other hand it will be seen from figures 8 and 9 that the growth of the new shoot has been checked by the cones formed at the top, and in consequence the immediate production of side shoots becomes necessary, which in turn produce flowers, but do not fertilize the cones of last year, which, as already explained, have become hard and unfit to receive pollen from this year's catkins. Many of these small unfertilized cones formed at the summit of the flowering stalk are already drying and falling off, and it is very probable that many of them drop within a month or two, while a few others remain persistent for over a year, just as the ordinary fertilized cones do; however the exact period is not known yet.

I further observed that while searching for those small cones to record their growth on a tree in the Forest School gardens in September 1903, it was quite impossible to perceive any. On looking again on the same tree on the 10th March 1904 I found a number of cones which I could not account for, the only reason being (as I have already proved) that the cones of *Pinus longifolia* are produced and fertilized in March, and they then grow to their full size in a month or two, and becoming mature in next May, as already stated.

Mr. E. M. Coventry has written in the "Indian Forester" for December 1903, page 573—"Last year's shoot terminates in a bud. In March or April this bud expands and develops into a shoot, which bears at or near its extremity the young cone.

When the shoot has expanded to its full length it is found to be terminated by a bud round which the young cones are situated." (The male cones are situated on and around the lower portion of the year's shoot, and drop off soon after they have shed their pollen. Male and female cones do not of course occur on the same shoot.)

Figures 1, 2 and 3 will clearly show that male and female flowers are on the same shoot in Dehra Dun.

DEHRA DUN :
Dated 18th March 1904.

BIRBAL.

Germany and America in Forestry Methods.

In the April number of the *Indian Forester* I have read a note on the part which Germany or rather the Forest Service of Germany are going to play in the World's Fair, which was opened a few days ago in St. Louis. The note interested me as I had just returned to Berlin from the Forst Akademie at Eberswalde, where I had been shown and told many instructive things and been received with great courtesy by Herr Oberforstmeister Riebel and Professor Dr. Karl Eckstein of Forst Zoologie Jamr.

Herr Oberforstmeister Riebel, an officer of long mature experience who now holds the position of Director of the Eberswalde Forest Akademie in Prussia, and is also the Administrative head of the Forests of Eberswalde and Frienwalde, has been deputed by the German Government to the St. Louis Fair in connection with the Forest exhibits and operations to be carried on there. The Oberforstmeister was greatly looking forward to the visit from which he hoped to cull some interesting information of use to his own department at home. Probably one of the reasons for this officer's selection was due to the fact that for the last 15 to 20 years they have been experimenting with exotics in the forests of this part of Germany with a view to seeing whether they cannot grow the kinds of wood now imported in fairly large quantities from North America, and to some extent from, I believe, Japan.

In the Frienwalde Oak and Beech Forests I was shown a considerable number of plantations consisting of various exotics, and in many instances the growth was quite remarkable. One cannot but wonder whether with this rapid growth, the wood will be equal in quality to that imported. To give an example, I saw a young plantation in which the Quercus-Americana trees were a third to a half again as high as the Quercus robur with which the species had been planted in alternate lines. Excluding a number of exotics, which are only of use as ornamental trees, I was given the following list of trees, from which they are of opinion it will be possible to form forests: Pseudotsuga Douglasii, Picea Sitkarnsis, Pinus strobus, Chamcecyparis Lawsoniana, Ptsuga Menziensis,

Quercus rubra, Q. Americana, Robinia pseudoacacia, Careya arborea (I saw some wonderful young hickory plants), Juglans nigra, all from North America, and the Japanese Larix leptolepis.

The woods imported from North America are chiefly Pinus palustris and P. Australis, Juglans nigra and Careya arborea.

I trust I shall be able to give or get himself to give in the pages of this Magazine some account of Herry Oberforstmeister's experiences and opinions on America and American forestry.

I understand that a Forest Conference will be held in St. Louis in August or September. It is probable that an Indian Forest Officer were he deputed to visit St. Louis would be able to obtain much information of value to his Government and Department. The Germans evidently expect to.

ST. PETERSBURG : E. P. STEBBING.
19*th* (2*nd May*) *April* 1904.

Reproduction by Sucker Shoots.

In his article in the April number of the "Indian Forester" Mr. A. W. Lushington suggests that the old term "root sucker" should be replaced by "sucker shoot," on the ground that roots never produce leaf-buds, whereas these stems arise from lateral superficial roots, which are really underground branches. I do not think "sucker shoot" is much of an improvement. These underground branches are to all ordinary intents and purposes roots, and it would surely be admissible to call the stems arising from them "root-shoots." The term would be simple, and would neatly distinguish them from "stool shoots."

The subject of Mr. Lushington's article is very interesting and his suggestions are perhaps capable of being worked out with valuable results. The matter is passed over very lightly in Forest Manuals, this being perhaps due to the fact that our manuals have so far been concerned only with European species, of which the more valuable do not appear to produce these shoots. It is different in India judging from Mr. Lushington's long list of good species which give root-shoots.

We spend much labour in coppices in trimming shoots to produce shoots, which then come up in a crowd at one point, leaving the spaces between the old stools bare, as before. If the lateral roots were systematically sought out by a light scratching of the ground we should possibly be able to do a good deal towards filling in these intervals between the old stools, and to space the new stems as we pleased, and this, in thin coppices, on poor exposed soils, would be of value. Mr. Lushington intimates that this has been done successfully, but only on a small scale, I gather, but I think the system is capable of considerable development.

There are often in high forests as well as in coppices bare hard spots upon which it is difficult to get up a growth of seedlings. Here we might hunt up the lateral roots of trees bordering the

blanks, and induce a growth of root-shoots. That this plan would be successful with certain species is likely, since Boppe says ("Traité de Sylviculture"): "It has been noticed that root-shoots are produced by preference on the roots of isolated trees, or, after the felling of trees, *on a soil exposed* by an exploitation to a full light."

This tallies with an experience of my own. Some years ago I clear felled (or nearly clear-felled) a piece of Shisham forest with the *immediate* result, not only that there was a tremendous growth of stool-shoots, but also that a number of *stems* appeared in the intervals between the old stools. These items were, I imagine, root-shoots though unfortunately I omitted to make certain. I am, however, practically certain, for I feel sure no seedlings could have developed as rapidly as these stems did.

In the case of Shisham it would thus appear that the development of root-shoots at a distance from the stool in no way interferes with that of stool-shoots, but this may not be the case with other species.

It would, however, perhaps not be wise to induce such reproduction on too large a scale in a high forest if it is really true that the longevity of a tree sprung from a root-shoot is smaller than that of a tree from seed. Still we have Bagneris' authority for saying that "suckers have *a better future* before them than stool-shoots, inasmuch as they have their *own* roots, and are therefore independent." Also suckers are rooted directly in the soil and are hence independent of the parent stool from the very beginning. ("Translation of Messrs. Fernandez and Smythies.") Boppe says: "The root-shoot frees itself easily from the parent root, to form an independent stem; better than the stool-shoot, it assures the reproduction and expansion of the tree; nevertheless its longevity remains attenuated by the original fault common to all trees *starting from an axis*."

As a wound will induce the development of the buds I would slightly graze the upper (or perhaps preferably the side) surface of the exposed root. Also probably a small root would be better than a large one, as being less likely to introduce rot into the new tree.

In this connection we may quote Mr. Fernandez's "Rough Draft of a Manual of Indian Sylviculture." He says "in the ground wounds are not at all necessary for the formation of these (adventitious) buds, although *they of course* continue to be an exciting cause. Adventitious buds on roots are the sole origin of suckers and are produced most abundantly on or near swellings, which prove the greater activity of the cambium there."

Boppe says ("Traité de Sylviculture"): "It has been stated that lesions made on the lateral, superficial (*traceantes*) roots of certain species, ordinarily little inclined to form root-shoots, may provoke the formation of such shoots."

DEHRA DUN:
11th April 1904.

A. G. HOBART-HAMPDEN.

Our Neglected Commercial Side.

In his letter of the 23rd November last, published in the April issue of the "Indian Forester," Sir William Thisleton-Dyer has shown that my short note under the above heading in the November (1903) issue is apt to convey an impression far

removed from that I wished to create, and I therefore crave further indulgence.

In no way do I wish to impute general neglect of the commercial value of 'Bhaber' grass in India, as I am well aware that a very considerable revenue is made in some forest divisions from this source, as is indeed obvious from my previous remarks.

All I wish to enforce is that with a central information such as advocated in the issue for June 1903 repetition of unsuccessful attempts like mine of last year would be avoided.

What was required when the experimental exploitation was begun was not to ascertain whether Bhaber grass is fit for paper-making but to obtain data as to the exact comparative value of the local product, cost of exploitation and of transport to the railway, and thence to the factories, and finally whether prices obtainable were remunerative.

Patently special figures must be worked out for each division owing to the varying cost of labour, means and distance of transport, etc. Here in Ganjam the grass has to be carted on an average for 50 miles to the railway, and thence the distance by rail to the nearest factory is about 400 miles.

The actual experiment carried through last year was not absolutely fruitless as useful information was obtained. However, had there been some record of the previous experiment readily available, the later one would have been on modified lines. It may be urged that the result of the experiment of 1886 should be forthcoming in the old records, and so they are to a certain extent; but firstly the present establishment was quite unaware of its ever having been made, and secondly in those days office records were not very systematically classified or carefully kept.

What was aimed at in the original proposal for a central information bureau, and what I would still insist on, is the necessity for some special branch being made responsible for dealing exhaustively with each article of forest produce, for collating and making readily available all necessary data for its exploitation in each division, and for providing every facility to divisional officers in placing forest produce on the best market.

CHATRAPUR, GANJAM:
20th April 1904.

C. E. C. FISCHER,
Deputy Conservator.

Road-side Arboriculture in India.

Anyone who has done much camping in the plains of India could not fail to be impressed with the thoroughness and success with which district officials of past days have converted glaring and

dusty roads into cool and shady avenues, which not only added very materially to the beauties of the landscape but conduced greatly to the comfort of the weary traveller in the hot weather. These avenues are especially noticeable along the old trunk roads, and on branching off on to one of the more recent side roads the wayfarer is at once struck by the equally conspicuous absence of such avenues or by the want of success which has so frequently attended the generally desultory efforts of more recent days.

We are glad to learn this is receiving the attention of the Government of India, who have asked Local Governments to furnish them with information as to the steps taken in recent years to plant new avenues and to maintain already existing ones. With the object of establishing a more sustained and uniform policy, not only for the development of new avenues, but for the preservation and renovation of old ones, they have also asked for suggestions for the improvement of the existing system, especially with regard to such matters as the issue of general instructions in the form of a manual of arboriculture, the preparation of well-considered programmes, and the training of a supervising staff.

For some few years back the Punjab Government have been taking some steps in this direction, and have been occasionally sending a few men to undergo a short course of practical arboriculture at the Imperial Forest School, Dehra Dun. We cannot help thinking, however, that no such training is necessary nor is a manual of arboriculture indispensable. In past days they managed to make admirable avenues without trained men and without a manual, and there would appear to be no valid reason why this cannot be done at the present day *if the money is forthcoming.*

This seems to us the *crux* of the whole matter. Now-a-days the money is wanted for sanitation, for education, for hospitals, and for a dozen other purposes which have first call when money has to be allotted for local expenditure, with the result that "no money is available for avenue planting this year; it must stand over."

If the money is provided, and if, as seems to have been done in former days, the tehsil authorities are made responsible for the avenues within their limits, there should be no difficulty in maintaining and extending our avenues. To be sure the native will continue to put two or three plants into each hole, but he has done this all along, and it has succeeded, and it is very doubtful if he will discontinue the practice in spite of what the Manual says.

Be this as it may, the steps now being taken by the Government of India cannot fail to be productive of much good, even if they result in nothing further than drawing the attention of Local Governments to the fact that they are conspicuously failing where their predecessors succeeded so admirably.

Coopers Hill College.

The correspondence between the Government of India and the Secretary of State with regard to the closing of Coopers Hill College has now been published. It will be remembered that a Committee, of which Sir Charles Crosthwaite, Doctor Jex Blake, the Dean of Wells, and the late Head Master of Rugby School, Mr. Hardie, a Member of the India Council, Sir Alexander Rendel and Mr. Leonard were members, was appointed to enquire into the necessity for retaining the Government Engineering College at Coopers Hill.

We have not the report of the Committee before us, but understand that the Committee unanimously recommended that the College should be closed, and suggested in detail a system by means of which the recruitment and training of Public Works and Forest Officers might be carried on without the provision of a Government College for the purpose.

In expressing their views on this report, the Government of India remarked that,—"So far as the question affects the Forest Department, we would point out that, though the number of recruits is small, only about eight a year on the average, yet the question of their training in the interests of our Indian Forest establishment, which is annually increasing in importance, and requires for its development, not only professional skill, but a high degree of administrative ability, is one of great importance.

"As regards the advantage to the general tone and status of the service, which accrues from bringing its future members together under discipline for some years at an institution to which they may feel proud to belong, all that has been said above applies to the Forest Officers with the same force as to the Engineers. In the matter of professional training, however, the two services stand on a somewhat different footing. There are no schools of forestry in England, nor does the country afford any opportunity for that practical training which is especially essential in the case of officers who, joining a department that is always short-handed, are posted at an early stage in their career to isolated and independent charge. In this respect we consider the present system to be defective, and we adhere to the opinion expressed in 1882 and 1884 that the system of continental training which was then abandoned in opposition to the strongly expressed views of the Government of India was superior to anything that is possible at Coopers Hill, in so far as professional training is concerned. Regarding the question as a whole we are content with the existing arrangements, which we have no desire to disturb. But if Coopers Hill College is to be closed we would strongly urge a reversion to the system which obtained before candidates for the Forest Service were admitted to that College, though we think that the arrangements then made for the supervision of the students while abroad were defective, and that more effective provision in that respect will be required."

The Government of India concluded its observations on the Committee's report by recommending unanimously that the College be maintained for at any rate a further period, and stated that the opinion of the heads of the three departments interested in the matter was strongly in favour of the College being retained.

Notwithstanding this strongly expressed opinion the fiat has now gone forth that the days of the College are numbered. Officers for the Public Works will be recruited from students of all the chief schools of Engineering in the United Kingdom, and from the information given in the Secretary of State's despatch with regard to the method of recruitment during the next three years, we understand that the closure will take place at no distant date.

As a further communication is to be made with regard to the *professional education of selected* candidates for the Forest Department it would appear that the suggestions of the Committee with regard to the recruitment and training of Forest Officers have not been similar to those expressed by the Government of India, *viz.*, that a reversion should be made to the system which obtained before candidates for the Forest Service were admitted to Coopers Hill College.

The Committee can hardly be described as a strong one from the point of view of knowledge of the attainments requisite for a Forest Officer, and with the exception of Mr. Hardie, we doubt if *any one of them has any practical acquaintance with the require*ments of the Forest Service in India. Some few months ago we ventured to throw out a suggestion for the future training of Forest Officers in case Coopers Hill were closed. This in no way runs contrary to the opinion expressed by the Government of India, and we think a scheme somewhat on the lines already sketched by us will meet the requirements of the case much better than would any attempt to train the candidates at one of the British Universities.

Mahogany and other Fancy Woods available for Constructive and Decorative purposes.

By Frank Tiffany.

In the Journal of the Society of Arts for February 26th, 1904, there is an interesting paper on the above subject, which was read by a Mr. Frank Tiffanny at the Eleventh Ordinary Meeting of the Society. The paper was not confined to woods, but also contained some remarks on the importance of forestry, and though in these there was nothing new, they are yet of value in spreading the knowledge of the necessity of the maintenance of forests. Mr. Tiffanny is only following a beaten track when he says that it is "an undoubted fact that our modern requirements of timber are depleting the world's forests far in excess of natural reproduction," and he is far from the truth when he says that "as yet practically nothing is being done to conserve or reproduce what is to man as vital as even food supplies." All civilzed nations are now taking steps to preserve and maintain their forests, and practically all our Colonies, even those of most recent establishment, are following the same lead. It is true though that in Great Britain itself little has yet been done, and that much could be done, but not to the extent that Mr. Tiffanny considers possible. Thus according to Mr Tiffanny "if we are to maintain our industrial supremacy something must be done to inaugurate an extensive and scientific system of the re-afforestation of the United Kingdom and Ireland with such timbers as experts may agree upon as being likely to thrive," and he states that "it would be a kindness to compel the inefficients to return to the land, and find them employment in forestry." This is stating the case much too broadly. The amount of timber that could now under the best of circumstances be grown in the United Kingdom and Ireland could bear but a relatively small proportion to the amount annually required, could only become available after about 80 years, and could not appreciably affect our commercial position; but re-afforestation of waste areas would add to the wealth of the country by making idle lands productive and cheapen the price of timber for home consumption. In talking of the "return of inefficients to the land" he descends to claptrap. This may be a good cry in the interests of agriculture in general, but forestry would afford little employment for such labour. As regards the woods available for constructive and decorative purposes Mr. Tiffanny states that "our object must be to learn the special characteristics of those which enterprise and modern

transportation have placed at our disposal, and whilst, however imperfectly, enumerating the purposes for which each is peculiarly adapted, it is essential not to hold a brief for any.........." But Mr. Tiffanny fails to act up to this ideal, and his paper distinctly favours mahogany, on the qualities and value of which he discants to the extent of three columns of print, whilst oak is only accorded a column and a half, and teak a miserable half column. The descriptions of 37 other woods are contained in four columns, and these include the important Australian and Tasmanian woods.

The salient features of what is required of any fancy wood are summarised as follows:—" Hardness of surface, but it must not be of such hardness as to render it potty, or brittle, so as to be difficult to tool: evenness of texture, that is, an absence of undue variation of alternate layers; cohesion of fibre along with an absence of resinous galls. It is also necessary that the wood should season more or less readily without a tendency to tear *itself into shreds, or to twist and warp when seasoned, nor should* it swell and shrink with every slight variation of atmospheric conditions.........Colour should improve with age; it militates against value when they fade, go black or become lifeless. Also in cabinet-making any wood which will not take glue is worthless."

Mr. Tiffanny mentions mahogany, oak and teak as the three leading fancy woods, but exception may well be taken to the inclusion of oak and teak in such a designation He states that mahogany if placed first must not take that place to the disparagement of either oak or teak. "The commanding position of mahogany is not due to any freak of fashion, but to its own intrinsic merits, along with the abundance of supply." No attempt is made to prove these assertions, and all that is said in praise of mahogany might equally well be said of oak and teak, or of some other woods, and as regards the abundance of supply, it is probable that quite as much teak is put upon the market as mahogany, but its area of utilization is larger. India absorbs enormous quantities of teak in construction work, and every maritime nation employs *great quantities for naval construction. Mahogany, it is stated,* was formerly principally obtained from St. Domingo, Cuba, Honduras, &c., but the quantities shipped from central American ports are now diminishing, but are compensated by the development of the African mahogany business. This mahogany comes from West Africa, Tagor, Benin, Oxicus and Assinee principally. Asiatic and Australian mahogany are lightly esteemed. Of oak and teak Mr. Tiffanny has nothing new to relate. The following reference to teak is, however, somewhat amusing: "Had this wood been available when Solomon built his temple at Jerusalem, probably with his wealth he would have preferred it to the cedar of Lebanon: it is however used in the pagodas of the East, and as a preferential treatment to our greatest dependency it is hoped that it will be the one wood used throughout

in the building of the great cathedral of Liverpool." Evidently Mr. Tiffanny esteems teak for its sacred character, and he is not free from the fashionable complaint of Fiscalitis. At the conclusion of his paper he says "whatever may be the outcome of the present fiscal inquiry, it is sincerely to be hoped that the products of the forests, especially tropical (as they are essentially our raw materials), will be accorded the most favoured clause, if not admitted absolutely duty free."

Of the other 37 kinds of fancy woods mentioned by Mr. Tiffanny in a few lines of description of each, the majority are of only academic interest to the "Indian Forester." They include only three woods obtained from India, *viz.*, Black Ebony, Padouk and Rosewood. Of Black Ebony he states that it is "highly suitable for small ornamental work...... veneers and mouldings in relief." Of Padouk, that it is of a deep red colour which fades from exposure. It will not take glue. When wrought it stands well, but it is costly to manipulate. When extreme hardness is required it makes a good countertop, but the general run of lengths are too short. It is also a splendid wood for gun carriages, &c." Rosewood is dismissed with a brief description far incommensurate with its value. "Thirty years ago it was considered a first class drawing-room furniture wood, but it has fallen into disfavour, although it is still used for pianaforte cases. As a wood it is costly and the size small, and is difficult to work. When newly worked it possesses a dark and frequently richly variegated figure, but fades with age, becoming very lifeless. As a moulding wood in relief it is very effective." Mr. Tiffanny is evidently unaware of the fact that this wood has been adopted in India by the Ordnance Department for gun carriages. Gun carriage factories have taken 80,000 cubic feet of this wood in the last three years from the North Canara forests alone.

The two Australian woods, Jarrah and Karri, of which so much is heard now, get very scant notice from Mr. Tiffanny, and both are damned with faint praise. Of Jarrah he says that it is "a hard dense wood of no beauty in appearance: considering the large size to which it grows it is a pity that its uses in this country do not appear to be available for much beyond that of a paving material, for which it is undoubtedly fitted." Of Karri, that it is "a similar wood to Jarrah, but of much greater tensile strength: to a small extent it is being used for the underparts of rolling stock; but whether it will be found to possess or retain that flexibility so charactersistic of oak remains to be proven, and its great weight adds materially to the dead load of the train. There is nothing in its appearance to commend it for general purposes." Mr. Tiffanny omits all reference to the main purpose for which these woods are being employed, *viz.*, railway sleepers, and also of the extent to which they are imported into England and absorbed there or re-exported. He is also quite wrong in his description of their appearance. Both woods are capable of taking

a very fine polish. At the Glasgow Exhibition of 1901 a large space was occupied by an exhibit of furniture, &c., made from Karri and Jarrah woods, including a very handsome staircase and hall decorations. Mr. Tiffanny has much to say about the introduction to the market of new woods. He refers to Mr. Gamble's lecture at the Royal Colonial Institute, where he spoke of the difficulty of introducing new woods, and adds his testimony to this; but he does not convey much encouragement to those who might wish to introduce new woods. The following remarks are quoted as being of interest and instructive, though not containing anything particular of novelty.

"The carrying of seasoned stocks of recognized fancy woods is itself a heavy tax on capital without loading it with an unknown and unproved wood, and if a merchant takes a risk he has no guarantee as to the continuity of supply at a price which would unable him to compete with recognized stocks.

"The introduction of new woods involves a considerable amount of missionary enterprise which rightly should belong to those whose interest it is to secure their introduction and acceptance.

"It is, however, futile to send here unlabelled samples which brokers cannot classify, and consequently give them such unmeaning names as "fancy woods" or "furniture wood," and hence they are frequently auctioned at prices which do not cover freight and charges.

"If a wood is worth sending it should have proper foster parents, who can give the trade some idea of the quantity available and the more important question as to the continuity of supply and the cost at which it can be placed on the market."

A discussion followed the reading of the paper at the meeting of the Society, but nothing farther of interest was elicited.

The Long Round to England.

PART III.

Canadian Forests: Their Importance.—We turn now to Canada. And first of all we must say that any forester who visits the Dominion is certain of receiving a warm welcome. The writer was unfortunate in only being able to spend a few days in the Provinces of Ontario and Quebec, but to travel at all thoroughly through these countries in four months is more than health, wealth or time would permit. In those few days however much interesting information was given by the Forest authorities and others interested in the subject, information which is probably as new to readers of the *Indian Forester* as it was to ourselves.

The points of resemblance between the forests and their working in the United States and Canada are many, of course, and there are also important differences. The forests of the Douglas Fir and other species belonging to the *Coast Province and Interior Provinces of the Pacific Forest District* extend from the south through British Columbia and along the slopes of the Rockies in Alberta, nearly 800 miles northwards. In the east the area of the White Pine forests approximately coincides with that of the administrative Provinces of Quebec and Ontario. With the White Pine are also associated the Red Pine (*P. resinosa*) and the Jack Pine (*P. Banksiana* or *divaricata*); the latter has a much wider range northwards and north-westwards. As in the U.S., the prairies of the territories of the Middle West are almost treeless. Nearly all the northern half of the Dominion is included in the *Northern Forests of the Atlantic and Pacific Districts*, with their forests of slow-growing spruce, which reach as far north as the limit of tree growth. In spite of the enormous wheat tracts of the west and the large settlements of the older provinces it is said that 75 per cent of the country is still under forest-growth. The principal species are almost entirely coniferous. Canada, according to its present boundaries, has the greatest wooded area of any country of the world. Not only so but owing to its geographical position, its climate and configuration, it is certain to be the greatest wood supplier in the future. At least if any other country can provide as much timber, none will be able to supply so much pulp wood, for although the spruce (*Picea nigra*, black spruce, and *P. canadensis*, white spruce) has been nearly exhausted in the Eastern Provinces in the more accessible areas (as has also been done in the corresponding part of the United States), the productive as well as unproductive areas of stunted growth in the north seem now almost inexhaustible.

What is being done.—In India we do not hear much about forestry from Canada, but on the spot the whole forest question looms large. For a large part of the present and future prosperity of the country is bound up with the welfare, the wise administration of the vast stretches of tree-growth, whether by the State or by private owners. And yet, as a whole, the Government, officially, is singularly apathetic. It is not that the instinct of the woodlands is not in the Canadians, and individual interest in the adoption of conservative methods among the officials and other classes is very considerable, but relatively very little has been *done*, and the organisation and staffs of forest workers for purposes of conservation are extremely small and utterly inadequate. And yet the necessity for such is just as great as it is in the United States.

True, in the latter the difficulty was, and still may be, to keep a sufficient area under forest to ensure a sufficient wood supply for home markets, while in Canada this could hardly occur, but the

duty of exercising a wise economy and of keeping timberlands under a fair standard of forest growth, whatever the latter may be, and of arranging the methods of harvesting and protection accordingly, is not less but more operative there. We cannot but say that we believe that the want of development of an organization and sound method of forest policy on a proper scale is due not only to the political influence exercised by the lumbering interest which was antagonistic to such in the past, but more to the failure of the highest authorities in the Dominion to appreciate the importance of the question and to their ignorance of the methods of forest economy. That this unsatisfactory state of things is also partly traceable to the lack of method which exists in the mother country admits of no doubt at all. If Canadians wish to conserve their forests, they must do it of their own accord.

This may seem a severe indictment, but it is not overdrawn. The heavy clouds of indifference have however lifted at one corner of the horizon, and the work that is being done by the small Governmental staffs, and also under the auspices of the Canadian Forestry Association, all of very recent origin, gives promise of better things in the future. But the amount of work which lies in front is enormous. A few remarks on exploration, land settlement, timber licenses, forest reserves, fires, plantations, will suffice to convey some idea of the present condition of affairs.

They are drawn from reports of the Superintendent of Forestry for the Dominion, *i.e.*, all outside the older Provinces, and from those of the Canadian Forestry Association, and from information kindly supplied by the Director of Forestry for Ontario.

Exploration and Land Settlement.—The third of the "primary objects" of the Canadian Forestry Association as detailed in its constitution is stated to be "to consider and recommend the exploration, as far as practicable, of our public domain and its division into agricultural, timber and mineral lands, with a view of directing immigration and the pursuits of our pioneers into channels best suited to advance their interests and the public welfare. With this accomplished, a portion of the unappropriated lands of the country could be permanently reserved for the growth of timber." Of Canada only the areas near the settlements have been explored in a detailed manner. Hunters and trappers and seekers for mineral wealth have no doubt wandered over the whole of the Confederation more or less, and it is mainly on their reports that information about the forests of the north is obtained. Comparatively little is known about the country in the older Provinces north of the watershed (height of land) which divides the rivers flowing into Hudson Bay from the tributaries of the St. Lawrence, and again in the north-west Territories, of all the ground more than about 600 miles from the international boundary. Exploration has, indeed to a large extent, failed to precede settlement in the systematic manner which is essential to the welfare of the country.

It has thus come about that in many and important cases land which has been opened for settlement (in much the same way as is done in the United States) has proved really unsuitable for the purpose, and again pseudo-settlers have applied for and obtained lands to settle, whether for themselves or as agents for others, merely for the sake of cutting out timber. In both cases, as also in the case of genuine settlers, forest fires are a common accompaniment, for the easiest way of getting rid of rubbish, which may include timber in this case, is to burn it. In any case the question is a thorny one, for it is difficult always to reconcile the interests of the often ignorant settlers on one side and of the lumbermen and the Government as owners of crown timber lands on the other, but with a better organised and more extended system of exploration, both the settlers and the country as a whole would be less liable to loss. The complaints from some lumbermen of loss to themselves from immature settlements are very loud. Exploration too is essential on behalf of the general community in order that a better estimate may be formed of the timber wealth of Canada with a view to future exploitation, for there appears to be no doubt that fire has passed over considerable areas of what has been assumed to be virgin forest with a large stand, leaving its commercial value a fraction of what it should be. The Government should be in a position to judge of the possible prospective value of undeveloped areas. The result of want of foresight in the past is that lumbermen are taking an unfair and probably increasing proportion of the profits on the timber of licensed lands, a part of which should be flowing into the public treasury.

Timber-licenses.—Many of the wealthiest men in Canada are lumbermen, and this will always continue to be the case. In the east they are coming into line in more conservative treatment of the forests. In the United States the lumber companies buy the land together with the timber on it. In Canada the land remains in the ownership of the State, but although in name the latter is by so much the better off, in reality the advantage does not seem to be very great. The practice in the province of Ontario is typical, and is as follows*: Formerly concessionists were allowed to cut timber on crown domains free of any charge. Afterwards "a system of timber dues was adopted and licenses were issued from year to year authorizing the cutting of timber within specified limits subject to the payment of the prescribed rates . . . . another step in the development of the system was the gradual introduction of the plan of disposing of timber-licenses at public auction . . . . the conditions of the timber-licenses were drawn so as to leave the Government free to withdraw from the territory included such land as might be required for settlement and allow homesteads to be located. In a large part of older Ontario the lumberman

* From a paper read by the Director of Forestry, Ontario, before the C. F. A., in March 1902.

thus became the pioneer of settlement and civilization, and in every locality where the character of the soil gave promise of successful agriculture the removal of the more valuable timber was followed by the opening up and cultivation of the land." The license-holders in Ontario now pay 3 dollars per square mile land tax and 1 or 1·25 dollars per thousand board feet of stumpage, together with the amount bid in auction to secure the monopoly. The timber-licenses are issued for one year only, but although this is so, "it has been the regular practice to renew them as a matter of course from year to year so long as the conditions were complied with and the annual ground rent paid, excepting only in cases where the land was needed for agricultural settlement. *Relying on the good faith of the Government*, licenses have been transferred from one holder to another, the same as bank stocks, without fear that the Government might exercise its undoubted legal right of cancelling the license at the end of the year." A case occurred in 1902 in which the license-holder transferred a license covering 129 square miles in Ontario to a well-known lumberman for 655,000 dollars, this large sum representing simply the right to cut or the accumulated 50 cents to 3 dollars per mile land tax paid by the limit-holder yearly for a number of years. True, the area had not been worked much for a considerable period, and the price partly represents the difference between 6 dollars, the value of the stumpage per thousand board feet, and 1 dollar, the Government dues on the latter. Undoubtedly a re-adjustment is necessary, and will be made in these areas of older development which will be fair to both parties. "In the sales of the last two years the term beyond which licenses will not be renewed has been fixed at ten years." In New Brunswick, to ensure a certain fixity of tenure to the limit-holders, enough to give them an interest in the well-being of their limits, the term is now 25 years, a long period. Thus in the older portions of the Provinces the limit-holders have a kind of vested right in the timber though not in the land. It is to be hoped that, in dealing with undeveloped areas, measures will be adopted to ensure a larger proportion of the profits coming to the State. Be this as it may, the interest which is being shown by lumbermen in the advantages of conservative lumbering, in fire protection, and again as members of the four-year old Canadian Forest Association is a hopeful sign for the welfare of the forests in the future. If State aid is required anywhere, it is required here in fostering this spirit and in giving aid and information.

General Forest Administration.—Next as to the formation of reserves. Before explaining how far this has progressed, a few words about the special forest administration and forest staffs will be useful. The five older Provinces, Quebec, Ontario, New Brunswick, Nova Scotia and Prince Edward Island, have each their own Local Government. The writer cannot say what special staff there is in the case of the first and of the last three;

but in each there is doubtless an adequate staff for the allotment and disposal of timber lands, for the control of the extraction of timber, and the collection of timber dues. In Ontario the office of Clerk of Forestry to the Government was created in 1883. "For some time after the creation of the office, the Clerk devoted his attention to educating the public as to the danger of deforestation owing to the over-clearing of farms and lands in the possession of private individuals. In 1895 the office was transferred to that of Crown Lands ...." and is under the Commissioner of the same........ and the Director of Forestry is now, at least, also the Director of Colonization. Since that time its work has been mainly directed towards the forestry problem in connection with the lands of the Crown rather than the reforestation of farm lands." The combination of the two offices of forestry and colonization struck us as, curious, but, given an adequate staff and sympathetic treatment the natural antagonisms disappear, and there is much to be said in its favour.

Reservations.—At any rate the Ontario Government has adopted a more progressive policy than that of the other provinces, and in 1893, by a Special Act, withdrew from settlement nearly 2,000 square miles of land unsuited to cultivation to form the Algongiun National Park. A Forest Reserves Act was passed in 1898, and since then three reserves of 125, 70, and 2,200 (Temagami) square miles have been made. A commencement has been made in the "creation of a large permanent forest on the watershed between the St. Lawrence and the rivers running into Hudson Bay. An estimate is given that the Crown forest of Ontario will ultimately comprise fully 40,000 square miles."

No reserves appear to have been formed in the remaining older provinces, but in Manitoba, British Columbia, Alberta, and Assiniboia some large tracts have been set aside. As at present constituted political administration of the first two is by a Lieutenant-Governor and Local Government, and the same is the case with the combined four territories of the *Middle West*, in which Alberta and Assiniboia are included. For Government forest work in these six, together with the five remote territories of the north, the post was created, four years ago, of Dominion Superintendent of Forestry. Forestry Branch of the Department of the Interior—this branch may be called on to operate over three-eighths of the whole Dominion of Canada! We shall hardly be wrong in saying that the size of the staff is in inverse proportion to the area of its charge.

In the four provinces or territories specially named above, the creation of reserves and national parks was commenced some few years ago. Up to two years ago eight or nine had been created in these areas of greater develoment, namely, four in and adjoining Manitoba aggregating over 2,000 square miles, and apparently forest land with little valuable standing timber, and four in Alberta and British Columbia in the Rocky Mountains, and westwards to

the Pacific; of these latter the reserves on the main range of the Rockies aggregate roughly between 5,000 and 10,000 square miles (the areas are not clear in the reports), and there is besides a railway belt 500 miles long and 40 miles wide along the Canadian Pacific west of the main range, with valuable timber along 350 miles of its length.

Thus the total area of forest reserves and parks in the Dominion aggregates something betweon 20,000 and 30,000 square miles. These figures, if only approximate, are a valuable indication and avowal of a policy of State forestry. As in the U. S., no work is yet done in the Canadian reserves, but they are protected, especially from fires.

Fires.—All the reports contain an amount of information about forest fires and the preventive measures adopted. Canada has gone ahead of the United States here. A great deal has been and is being done, but much remains to do in the more settled parts of the Dominion. The great difficulty seems to us to lie in giving protection to the more undeveloped and remote areas which may be expected to be exploited for timber or settled within a period which is but a fraction of the life of the forest It is in these that disastrous fires ravage unchecked, while in the former very large conflagrations are now uncommon. Fire prevention Acts have been enacted in all parts of the Dominion. In all the reserves fire-rangers, drawn from the neighbouring population, *are kept on during the dry periods of the dangerous months,* April to September, and their efforts have met with much success. In the instructions issued to them from the office of the Forestry Branch of the Dominion we find that the principal causes of fires are settlers, railway engines, camp-fires, hunters, prospectors and fishermen. The first has already been referred to; as to the second special clauses of the Fire Act pertain to the railways. Though fires constantly originate from the last two causes, control is more easy than would be supposed owing to the large number of lakes great and small in the country, with the consequence that, transport being largely by canoe, the lines of communication are limited and defined; also doubtless lakes and streams form effective fire lines. Partly for this reason the fire staff is extremely small.

In Ontario too, at least, lumbermen are compelled to protect their own limits, and in all but a few cases would do so without compulsion; indeed they claim better results for their protection than are obtained by Government. In a report compiled for the C. F. A. on the fires of 1901, we find that the biggest fire (an exceptionally big one) in Ontario in the settled portion was one of 120 square miles on the borders of Quebec, and in the unsettled districts one estimated at 300 square miles. None of such magnitude are reported elsewhere, except one of unknown extent in British Columbia, and it would appear that very few single fires burn more than 5,000 acres. Still the value of timber destroyed in these coniferous forests is very large. The lumbermen etc., of

British Columbia are among the worst sinners; the forests seemed so endless, timber per unit is worth less than in the east and the bad example of the far western States of the U. S. is near at hand.

That very considerable sums are already being spent on fire protection is evident from the fact that nearly 30,000 dollars were spent in 1901 by the Provincial Government of Ontario alone.

Planting.—Finally, mention should be made of the extensive co-operation of Government with the settlers in tree-planting round homesteads and farms in the treeless parts of the prairies of the Middle West. This work, begun in 1901, has assumed large dimensions, the number of applicants for trees for 1903 being 436. The trees supplied are of the indigenous species, maple, cottonwood, elm, willow, ash.

The main heads treated above in the consideration of forests and forestry in North America have been organization, and in some degree administration and protection. Sylvicultural questions are ever interesting, and the reproduction of principal species in the numerous zones of the Great North American forests opens a wide field for speculation and work. It is, however, outside the scope of the present paper with the exception of the few lines already given to it.

Practical Exploitation.—Exploitation is written large on the face of all accessible areas. As regards the practical work of exploitation, the writer enjoyed some exceptional facilities in visiting one of the lumber camps of the St. Paul and Tacoma Lumber Co., State of Washington, and seeing the method of extraction by means of donkey-engines (bull donkeys), and again in inspecting their saw mill, and also that of Messrs. Booth of Ottawa, two of the largest concerns in the lumber world. A short description has already been given of the forests of the first. They are situated some 30 to 60 miles from the mill at Tacoma, which stands on the Paget Sound, an arm of the Pacific. To supply the mill 75 to 85 truck loads of timber, averaging 6 logs apiece, mostly of Douglas fir, are sent in from the 7 lumber camps, and about 2,000 acres of forest are cut over clean each year. The logs now taken out are 24 to 48 feet long, and 2½ to 4 feet in diameter at the butt end. Exceptional orders have been met for pieces 130 and 160 feet long. The timber taken out to the Ottawa mill is, at an average, much smaller and less clean, and the wastage in the forest proportionately less; this is due to the cheaper carriage by water to the mill, to the greater but poorer quality of the white pine timber now available, and to lower wages of the mill and forest workers. The capacity of the Ottawa mill is, we were told, one million board feet per day, or twice that of the Tacoma mill, itself an enormous concern, and Messrs. Booth's licenses cover 4,000 square miles.

SMALL GAUGE RAILROAD AND MAIN DONKEY ENGINE.

LUMBERING NEAR TACOMA: A DONKEY ENGINE PULLING ITSELF ALONG A ROADWAY.

Cutting and Transport.—In the Tacoma Co.'s forest, then, the exploitation, which is typical of many other concerns, is as follows: The railway which runs from the mill consists of two parts, the first with standard gauge, easier gradients and trucks of the ordinary type; the second, which may or may not be required, with narrow gauge, higher gradients (maximum 12 per cent), and small, specially powerful locomotives for dragging a chain of logs down along the slightly hollow wooden track laid between the lines. This conducts us to within a mile or less of the scene of actual cutting operations To get the timber down from the slopes, narrow roadways or skidways are made into the forest, as shown in the photograph, consisting of three or four logs laid side by side longitudinally, or of short cross pieces which are let into the ground at intervals of 9 feet; these ways are not more than a quarter of a mile apart. A donkey, engine fixed on a strong sledge, is placed at the junction of the railway with the roadway, and after it has hauled the timber from the forest in the immediate vicinity (these yarding engines work with a radius of 200 yards or so) it advances along the roadway pulling itself the required distance with the help of the tree stumps, and if necessary up steep gradients, and a "main" engine is then placed in the first position. The "yarding donkeys" haul single logs from the forest to the road, the "main donkeys" along the road, and these latter may work with a wire rope of half to one mile in length, hauling a chain of logs Generally speaking, if the distance become excessive an intermediate donkey engine is placed. We were informed that the donkey engines work from 20 per cent (on level ground) to 50 per cent quicker than horses, which in their turn superseded cattle in the haulage, and that the saving on horses is 40 per cent or so. The "donkeys" work in wet weather or fine, and thus keep the mill constantly supplied, an important point. On the other hand, they consume 250 stacked cubic feet of fuel a day and a corresponding amount of water. There is no lack of either here. Great use is made of pulley-blocks with short rope lengths fixed to tree-stumps both on the roadways and in the forest to guide the logs round awkward corners.

Conversion.—The main features of the two saw mills visited were very similar. The round and sawn timber is transported through the mill by a succession of endless chains and rollers. In the Tacoma Mill are four band-saws. The log to be sawn is rolled up laterally to the trolley, on to which it is clamped, by means of an arm or nigger working from below the floor surface, and the trolley is then run up to and back from the band-saw with great rapidity. The newest band-saws are toothed on both sides, and can be moved up or down, frame and all, according to the size of log and work to be done. After being dealt with by the band-saws the sawn timber is trimmed by circular saws. For trimming laterally a very clever piece of machinery was shown. Planks of various lengths pass up one by one laterally on three parallel slightly inclined endless chains to a dozen

circular saws suspended in frames, above them, the line through their axes being parallel to the plank; the saws are controlled by levers at some distance, handled by a workman, who lets fall two or more of the saws according to his judgment and the quality of the timber. The planks are not cut at any special angle to grain. Clear wood without knots is worth two or three times as much as knotty material. Many shingles are also cut by means of circular saws. Not the least interesting part of the Tacoma Mill is the drying kiln, for rapidly seasoning planks, small scantlings and small stuff; it is a long brick building with steam pipes. The timber passes through in seven days, after sawing, and the weight is reduced about two-thirds. This could only be used for soft woods.

Cost of the journey.—In conclusion, it may be of interest to state that the trip starting from the north of India took exactly four months and cost just over £ 250. Twenty days were spent in Japan at a cost of £1 a day, thanks to the excellent arrangements made for us. In the United States forty-two days' stay and travel cost £ 2-6-0 a day, and six days in Canada a little less. Forty-four days' sea voyage cost £ 75.

R. C. Milward.

Cosmic Desiccation.

Prince Kropotkin recently read a paper before the Research Department of the Royal Geographical Society, in which he discussed the desiccation of Central Asia and of the Caspian steppes of the lower Volga, and of the whole of south-eastern Russia. The conclusion to which he came was that recent exploration in Central Asia had yielded a considerable body of evidence, all tending to prove that the whole of that wide region is now, and has been since the beginning of historic record, in a state of rapid desiccation. At the present time evaporation over the whole of Central Asia is very much in excess of the precipitation, and the consequence is that from year to year the limits of the deserts are extended, and that it is only in the close neighbourhood of mountains, which condense vapours on their summits, that life and agriculture are possible with the help of irrigation. Prince Kropotkin traced the progressive drying up of lake systems and of rivers, and came to the conclusion that the destruction of forests was an insufficient explanation to account for the phenomena. His own view was that the desiccation that was going on over the whole surface of Europe and Asia, but more especially over the northern and more elevated portions of those continents, had been continuous since the end of the glacial epoch. We are living in a geological epoch of desiccation, an epoch as characterised by desiccation as the glacial epoch was characterised by the accumlation from year to year of unevaporated and frozen precipitation. He suggested that this was a subject worthy of investigation by men of science, and also that such measures as experience dictated should be taken for combating, within the limits of the possible, the coming drought. Possibly one of these measures might be tree-planting on a large scale in the menaced regions and the sinking of artesian wells, which appear to have given good results in northern Africa.

Forestry in Wales.

This important branch of rural economy in Wales is in a sadly neglected state, and beyond all doubt calls for immediate legislation either by the Government direct or through our various County Councils in the Principality.

Such a state is mainly due to the management in bygone days and the day in which we live, and equally so to the ruthless extravagance of landowners who have spent their money in other ways than improving their estates, and as such has been continued for generations, our woods and what remains of our forests are in a most wretched condition. But it is the duty now of all true Welshmen who desire the commercial welfare of their country to include forestry as a national requirement, and to propagate its study and its furtherance with tongue and pen wherever the same is possible. Of course, we cannot expect much in this matter from those who live in large towns, their minds being almost fully occupied in their own individual branch of industry; in fact, if you speak to some in town and country alike about "forestry" they conclude at once that you are going to speak of a friendly society.

It was not many days ago that a traveller called upon the writer of this article offering an encyclopedia published by a well-known London firm, and on asking him whether there was anything in it about forestry, he replied, "Oh, yes; ever so many pages are devoted to friendly societies." After an explanation he discovered our meaning, and then told us that there were chapters in it by a German, a Frenchman, and an Englishman on the class of forestry we are now writing of. We wondered how it was that there was not a Scotchman, because Scotland has done, and is doing to her credit, great things for the betterment of woods, forests and foresters, and many of her sons are holding important appointments on some English and Welsh estates.

To better the present condition of woods and forests in this country it is essential for us to win over to our side all large landed proprietors, many of them being M.Ps., and if not members of Parliament, they certainly carry influence and power with those who are. It is necessary to lead those noblemen and gentlemen to see that it is to the nation's interest and welfare, as well as their own, to care for our arboriculture as it should be cared for.

The management of woodlands demands intelligence and proper training. We would not speak disparagingly of many of the men who are now at the head of the staff of woodmen; but, nevertheless, we will say this; that they themselves and the woods under their care would have fared better had they received a proper early training. We do not suppose for one moment that a forester should be a bachelor or doctor in science, but he should certainly know every branch of science which concerns his profession. He should study botany, vegetable physiology, chemistry and kindred sciences required by any man who is desirous to be a forester indeed.

We believe once the landowners and others are led into the light of this there will be a dawn of better times for our woods and those who labour in them, as evidently much of the money

spent abroad can be kept in our own land to the comfort and welfare of the inhabitants.

On the whole, forestry is beginning to demand a little more attention in Wales than has been accorded it in recent years. Large areas have been planted with larch and pine, and our County Councils have taken a step in the right direction.—*Timber Trades Journal.*

British Forest Trees.

Professor G. S. Boulger, F. L. S., F. G. S., gave a lecture to the members of the Ealing Natural Science Society recently on "British Forest Trees." He treated as indigenous the oak, holly, hazel, hornbeam, birch, ash, hawthorn, alder, willow, asper, spindle-tree, cornel, wych-elm, maple, apple, rowan, sloe, and yew. Dealing with the natural history and uses of each of these in succession, he remarked that, down to the beginning of the eighteenth century, oak was practically the only timber used in this country for building and domestic purposes, and it was then displaced in favour of the fir, by this country obtaining control of the Baltic trade. Of all our trees none has wood which is both equally tough and hard as that of the oak, and these qualities of toughness and hardness are apparent in the growth of the tree, which, with its straight stem and horizontal boughs, defies the laws of gravity. The durability of oak timber is shown by many well-preserved examples of ancient work, such as the roof of Westminster Hall, which is proved now not to be of Spanish chestnut, the piles from the Savoy Palace and from Old London Bridge, and a dug-out canoe from the pre-Roman village at Glastonbury. King Arthur's round table is a section of an oak eighteen feet in diameter, but its antiquity cannot be carried back beyond the reign of Henry VIII. A less known tree is the hornbeam, the toughest British wood, which flourishes on the cold clay of the home counties. Formerly it was used for yokes for oxen (whence its other popular name, the yoke-elm), and is still used for cog-wheels. As to the hazel, it is curious that John Evelyn, our first authority on forestry, derives his name from the old name of the tree "avelan." In the same way the names of the great botanists Linnæus and Lindley are derived from the linden. It is to be observed that the hazel is always used for the dowsing-rod, though any other wood serves

equally well. The birch can be used for very many purposes. Before the introduction of the fir and larch, it was the principal timber in Scotland, and it was then said that the Highlanders made everything of it. This holds good at the present day in Russia and Canada. The bark is more durable than the wood, and is used for roofs, canoes, mocassins, and vessels to hold liquids. Further, it is valuable for tanning, and imparts its peculiar claimed aroma to Russian leather. The lecturer claimed that some of our yews are the oldest of living trees, their antiquity being estimated at 2,000 years. They are older than Christianity, the churches having been built near them. No wood resists decay better than the yew, and it is a saying in the New Forest that a post of yew will outlast a post of iron; certainly a living yew will. Professor Boulger was disposed to treat the elm as a native tree, as trunks have been discovered in the deposits of pre-human times. He pointed out that, although the seeds do not ripen in this country that is practically true wherever the tree grows. He was more doubtful about the beech, of which the same evidence of antiquity does not appear. Still, it is a tree which flourishes here, and has the remarkable property of ousting all other trees except the holly. The beech shows us what an important matter forestry is, on account of the large industries which it creates. Through the beech woods of Buckinghamshire has arisen the chair-making industry of High Wycombe, which supplies both a home and a foreign trade. The manufacturers have to import wood for the best work simply because sufficient attention is not given in this country to forestry. The planting in England has been done almost entirely for the protection of game, and a hope is to be expressed that our landowners will see that it is an advantage both to themselves and the country to introduce the scientific methods of Germany.

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Pioneers of Indian Forestry.

CAPTAIN FORSYTH AND THE HIGHLANDS OF CENTRAL INDIA.

BY E. P. STEBBING.

Last year Colonel Pearson gave us some most interesting recollections of the infancy of the service in the Central Provinces, and in doing so incidentally mentioned the selection and appointment as Assistant Conservator of Forests of a young Punjab Infantry Officer by name Lieutenant Forsyth, a remarkable and gifted man, who but for his untimely death at the early age of 33 would undoubtedly have inscribed his name as one of India's great Administrators. I propose in these articles to give some description of the man and his work, both well worthy to be kept ever green in the memory of his successors, and of the conditions of the country at the time he worked in it. My notes are chiefly gathered from his own 'Highlands of Central India,' which he did not live to see completely through the Press. No greater praise is required for this book than to say that it is well worthy of the man and that it should find a place on the shelves of every Forest Officer, of every sportsman and lover of nature, serving in India. Would that more such were in existence. Modesty is a good trait, but, like many other good things, pushed to extremes verges on that border line or crosses over it !) which separates it from foolishness on the one hand and laziness on the other.

Captain Forsyth was born in the year 1838. He entered the Bengal Staff Corps, serving through the Mutiny. He was appointed to the newly-raised 25th Punjabis in 1857, and served with them till the beginning of 1862, when he joined the newly-constituted Forest Service as Assistant Conservator, and commenced work in the Pachmari Hills early in January of that year. His reasons for quitting Military employ sum up the character of the man.

"On the 11th January I bade adieu to the pretty little station of Jubbulpore (now fast becoming a large and important Military cantonment), and to my comrades of the gallant 25th Punjabis. I was really sorry to see the last of the jovial, manly company of Sikhs who composed the Regiment, one of the first

of the force that rose on the ruins of the Bengal Army in 1857. But soldiering in India, in time of peace, is truly one of the dreariest occupations; and I confess I was far from doleful at the prospect of quitting the bondage of parade routine for the free life of the forest; and to think that

"No barbarous drums shall be my wakening rude;
The jungle cock shall crow my sweet reveillé."

As the name of Forsyth's book implies, the country in which he served was a hilly—in other countries remote from the shadow of the mighty Himalayas one would say a mountainous—one, situated in what are now known as the Central Provinces. For the benefit of those unacquainted with the configuration of this portion of the continent a short description of the area and its inhabitants will perhaps be not out of place.

In the region to which the term "Highlands" is applicable several of the great rivers of India have their first sources and pour their waters into the sea on either side of the Peninsula—to the north the Son commingling with the Ganges, to the east the Mahanadi, flowing independently to the Bay of Bengal, to the south some of the principal feeders of the Godavari, and to the west the Narbada and the Tapti, taking parallel courses to the Arabian Gulf. If the head waters of these rivers are sought out on a map, the reader will become acquainted with the region in which Forsyth's work was carried out. It forms the central and culminating section of a ridge of elevated country which stretches across the Peninsula from near Calcutta to near Bombay, and separates Northern India or Hindostan proper from the Deccan, or country of the south. The general level of what may be called the plains of this area here gradually reaches an altitude of about 1,000 feet above sea level. Ranges of hills, at first fairly low but in places attaining a height of 1,000 feet, rise from the 'plains,' and beyond these peaks and plateaux present themselves evidently much higher. Valleys are everywhere found penetrating the hills, by following which one rises to these higher regions in which the cultivation below changes to forest-covered land or waste scrub.

In this region all is chaos to the unguided traveller; hill after hill of the same wild, undefined character are piled together, the streams appear to run in all directions at once, and to understand the geography becomes a difficult matter. A study will show that at about 1,000 feet above the level of the 'plains' (or 2,000 above sea level) the hills have a tendency to spread out in the form of plateaux; some comprising the top of only one hill and a small area; others like a group of many hills, which support, like buttresses, on their summits large level or undulating plains. From these again it will be seen that a good many flat-topped hills rise up, reaching the height of nearly 3,500 feet, some of which in like manner unite into plateaux at about the same elevation. Yet higher than these but never assuming the character of a

plateau here and there a peak may be seen rising to nearly 5,000 feet above the sea. To the Range in which Forsyth's work was done geographers have applied the name Satpura. The Hindus of the plains have, however, several names for different *sections, terming the most easterly the Mykal, the centre the* Mahadeo, and the western the Satpura hills. From its western extremity in the fork of the Bhusawal-Jubbulpore and Bhusawal-Nagpur Railway lines the mountainous region extends eastwards for a distance of about 450 miles with an average breadth of 80 miles.

There is little historical record of what took place in this extensive tract prior to about the middle of the 16th century. The country was called Gondwana and was inhabited by a people termed the Gonds. It is probable that during the 14th and 15th centuries a great immigration of the Rajput clans took place into the country of the aborigines, the Rajputs recoiling from the Mahomedan invaders of Upper India who were then pressing into the country between the Ganges and Narbada rivers which the former occupied. The Rajputs apparently intermarried with the indigenous tribes to a certain extent, the chiefs, however, keeping their descent pure and ruling over the intermixed races. With the *establishment early in the 17th* century of a strong Mahomedan Government under the Great Akbar, the impetus given to the development and civilization of the dark regions of India by the wise rule of that great administration led to the immigration and settlement of large colonies of the industrious agricultural races who had already reclaimed the soil of Northern and Western India. The Gonds retired to the higher plateaux and slopes of the Central hills, where their hunting instincts and rude system of raising coarse grains on which they existed could still find scope. The more extensive plateaux were also soon invaded by the aggressive race and their level black soils covered with crops of wheat and cotton, the surrounding belts of rugged unculturable country remaining in the hands of the aborigines. Thus ere long the tribes were not only surrounded but interpenetrated by large bodies of Hindus. When the Maratha power began to supplant that of the Moghuls in the latter part of the 18th century, the hordes from the Deccan began to overrun the country of the Gonds, but the conquest assumed little of a practical character in the interior of the hills, the mountaineers continuing to wage a desultory war against them from their fastnesses. At the beginning of last century the Gonds and Bhils were little better than hill robbers, the exactions of their oppressors having reft from them the last of their possessions in the plains. It was at this period, if not before, that every pass in the hills was crowned by the fortified posts of the hill men, the ruins of which are so common throughout this area at the present day, picturesquely overgrown with the thick tangle of an Indian jungle growth, the lair of many a forest denizen. In the year 1818 this state of things was put

an end to by our final success over the Marathas and the extermination of the plundering bands. But the new territories which we acquired had been almost desolated by a quarter of a century of utter absence of government, whilst the hill people were frenzied by the excitement of a life of plunder. The Saugor and Narbada territories, as the northern half of the country was then called, were acquired by us in full sovereignty after this war. The southern portion remained nominally the territory of the feudatory Raja of Nagpur, but had long been under British Administration when, in 1854, it too was annexed on failure of heirs. The Gavilgarh hills in the extreme south-west formed part of the Nizam's territory of Berar; but that also has been for many years under British management. With the establishment of a strong Government the hill men soon became a submissive and law-abiding people. They were, however, left pretty much to themselves and little exploration of their hills had been undertaken during pre-mutiny days. Along with many more important provinces, however, this secluded region felt the benefits of the impulse the Mutiny gave to the administration of the Empire. The iron road was to be driven through the heart of its valleys, and Manchester began to look at its black soil with an eye to cotton. In 1861 the province known as the Central Provinces was constituted under the Chief Commissionership of the late Sir Richard Temple. Under this energetic and tireless man things very soon altered for the better in this neglected area. This Chief was not long in perceiving that the highland centre of the province, with its extensive forests and mineral wealth, its limitless tracts of unreclaimed waste and scanty half-wild population, and its great capabilities for the storage of precious water was worthy of a principal share of attention. It had already been whispered by a few that its forests, calculated on by the projectors of the railway lines, then being constructed through the province, for their supply of timber, were likely to prove a broken reed, having been already exhausted by a long course of mismanagement; and one of the first steps taken was the organisation of a Forest Department, for the detailed examination and conservation of the timber-bearing tracts. An Officer, Captain (now Col.) G. F. Pearson, so well known to us all, who had already interested himself in the question, and had travelled extensively in these regions, and who was admirably fitted for the task by physical qualities, and the possession of that faculty of observation which is not to be acquired either in competitive examinations, in the study, or on the office stool, but which is an absolute *sine qua non* in the Forest Officer, was selected as the Superintendent of the new Department. A better choice could not have been made. During the next five years several officers, of whom Forsyth was one, were unremittingly employed in the exploration of the 36,000 square miles, which may be taken to be the area of the Central hills, besides doing much to examine an

almost equally extensive tract of low-lying forest in the south of the province. It was soon found that the claims to ownership of both cultivated and waste lands were in a state of utter confusion. The courts became congested with disputes as to the former, whilst culturable wastes became more and more in demand as settlers pressed into the country—a demand which the shortly-expected opening of the railway promised to largely increase. The forest questions also became urgent, timber being required in large quantities by the railways, whilst a fear arose of the impending exhaustion of the forests of the country. Nothing could be effected in the latter direction until the question of title in these wastes had been determined. To effect this Government appointed special Settlement Officers in every district in the province and ten years' hard work enabled the matter to be set at rest. The grand result as affecting rights and interests in the land was that where any title that could be converted into a right of property was established, the freehold, bearing liability to the fixed Government rent-charge, was bestowed on the claimant; while all land to which no such private title could be established was declared to be the unhampered property of the State. Most of the hill chiefs were admitted to the full ownership of the whole of their enormous wastes, though certain restrictions as to the destruction of the forests were here (as in all civilised countries except Great Britain) imposed on the proprietors. Under this settlement (in which Forsyth served as Settlement Officer of Nimar for three years, drawing up a report which was said to be second only to that of Sir Charles Elliott) about 14,500 square miles only in the Highlands remained to the State, of which 9,500 were considered culturable and the rest barren waste. A portion of this area was reserved from disposal to private persons as State forest, but in every district there was much good land available for sale or lease.

The total population of the tracts we are considering was in Forsyth's time about $4\frac{1}{3}$ millions, of whom about $3\frac{1}{3}$ millions were Aryans and one million only aboriginals, of whom the great majority (826,484) were Gonds, they being distributed in greater or less density over the whole of the hilly portion of the tract. In the extreme north-east were about 37,000 of the tribe known in Chota Nagpur as Kols, a race closely allied to the Santals. In the very centre of the Highlands on the higher plateaux of Pachmari and Gavilgarh, surrounded and isolated by the Gonds, were another race called Kurs or Korkus, numbering about 44,000, whose language and general type are almost identical with the Kols and Santals. All these Kolarian tribes differ radically in language from the Dravidian Gonds. Further to the east again in the Mykal Range, embedded amongst the Gonds, were a small body of about 18,000 Bygas, mère hunting savages, who had entirely lost all trace of their own language and spoke a rude dialect of the tongue of the Aryan immigrants. They present some

points of affinity to the Bhils of Western India, of whom also in the extreme west some 20,000 were reckoned in this mixture of tribes. The number of the aborigines was made up by some 25,000 souls, the fag-end of tribes with neither language nor country of their own.

As the region thus forms a mustering place of many races of man, so is it also remarkable as forming a place of junction of several forms of vegetable and animal life which seem to be characteristic of North-Eastern and South-Western India.

Perhaps the principal forest tree of Upper India may be said to be the sal (*Shorea robusta*), a tree whose habit it is to occupy the whole of the area on which it grows to the exclusion, more or less, of all other species. It forms vast forests in the Lower Himalaya, and covers also the greater portion of the hilly region to the south of the Gangetic Valley. From the latter tract it stretches along the tableland of Chota Nagpur, thence extending into the Central Provinces in two great branches, separated by the open cleared plain of Chattisgarh. The southern branch reaches as far as the Godavari River, and the northern embraces the eastern half of the highlands I have described, both branches ceasing almost exactly at the eightieth parallel of east longitude. To the west of this the teak tree (*Tectona grandis*) comes in. This tree is absent in Northern India and Bengal and is found but sparingly in the Central Provinces to the east of 80° longitude. It is not so exclusive in its habit of growth as the sal, appearing rather in the form of scattered clumps among other species than as the sole occupant of large tracts. Of the two the sal was undoubtedly best adapted to survive under the peculiar conditions to which both were exposed before the advent of a protective Forest Department, owing to its remarkable powers of propagation, the tree shedding an enormous number of seeds at the commencement of the rains, after the usual jungle fires which annually swept over the forest tracts, which germinated immediately on reaching the ground. The teak, on the other hand, seeding after the rains, was not in this advantageous position, since the seeds, covered by a hard shell which requires long exposure to moisture and heat before germination can take place, were exposed to the dangers of a fire season before they could sprout. The geological formation appeared also to be a great determining factor in the species of tree present in the forests at the time of Forsyth's inspection of them. It was noted that the sal shunned the trap formations, it being unknown within the great trappean area to the west of the 80° of longitude, whilst even to the east of that line in its own peculiar region it did not grow where isolated areas of the trap rocks were found. On the other hand examination showed that though the teak did not appear to shun any geological formation it thrived best on the trap soils which predominated in the south and west of the province. Forsyth's conclusions were that the sal exterminated the teak wherever it met with it on soils favourable to both.

Instances are numerous in the tract with which we are dealing. Occasionally isolated patches of sal are found, perhaps surrounded on three sides by teak, the fourth being open cultivated country with sal forest beyond. An examination of the geological formation on this fourth side showed that it is not trap and was, previous to the advent of the cultivator, in all probability occupied by a continuous strip of sal forest. In this manner Forsyth was, able to explain the at first unaccountable distribution of the two trees and accumulate some sylvicultural notes of infinite value to his successors. This peculiar distribution in two of the chief forest species of the flora of the area would seem to be also followed by a corresponding distribution in the fauna of this region. Equally with the sal tree several prominent members of the Central Indian fauna belong peculiarly to the north-eastern parts of India. These are the wild buffalo (*Bubalus arni*), the twelve-tined swamp deer (*Rucervus Duvancellii*) and the red jungle fowl (*Gallus ferrugineus*). All these were plentiful within the area of this great sal belt in Forsyth's time, but did not occur to the west of it except in an isolated inaccessible sal patch in the Denwa Valley, when the two latter again recurred. In so small a patch the buffalo would have quickly been exterminated by the inhabitants of the neighbouring cultivated land.

Two other large representatives of the eastern and western faunas, the wild elephant and the Asiatic lion, also appear to have extended far into this region. In modern times however the advance of cultivation and persecutions of the hunter have driven them both almost out of the country here dealt with. The former in the time of Akbar (*vide* Abul Fuzl's 'Chronicles') ranged as far west as Azirgarh, but is now confined to the extreme east of the province and on into the sal covered hills of Chota Nagpur. Sir Thomas Roe, ambassador from James I to the Court of the Great Mogul in the 17th century, speaks of the lion as being then common in the Narbada Valley. It is not now heard of to the east of Rajputana. Forsyth states that a lion was killed in the Saugor district in 1851 and another in the sixties a few miles from the Jubbulpore-Allahabad Railway. The hog-deer (*Axis porcinus*), so common in the sal tracts of Northern India, Forsyth never met with in the west of the province, nor did he find it numerously in the east. The black partridge (*Francolinus vulgaris*) of Northern India is replaced here by the painted (*F. pictus*), a closely allied species, and the great imperial pigeon of Southern India does not apparently cross the Narbada to the north, though not uncommon in the higher forests to the south of that river. These few short remarks on the distribution of the fauna could be easily lengthened, and it would be of the very greatest interest, both from a sportsman's and a scientific point of view, if some of the famous shikaries contained within the ranks of the service would publish in the pages of the *Indian Forester* any lists of the local faunas they will doubtless have prepared on their

trips for their own personal use and reference. I may here supplement Forsyth's notes on this subject by a remark on the Insect fauna of these two types of forest. Species have been found in the northern sal areas with identical or closely allied forms present in the Central Provinces, Chota Nagpur, Western Bengal and North-East Madras sal tracts, whilst species identical or closely allied present in the Central Province teak country reappear in Madras and even in Burma teak areas.

(*To be continued.*)

Deboisement and Decadence.*

I.

In the beginning, deboisement (the clearing of forest) was a work of civilisation, for the forest had to be destroyed before the earth could be cultivated. The axe being too troublesome an engine of destruction, fire was employed, or the trees were killed by girdling (N. America). In place of the ancient shades appeared the yellow harvest, agriculture took the place of hunting, and the latter means of existence is now only practised by a few nomad races.

Primarily, then, civilisation required the destruction of the forests, but this destruction, now pushed to excess, has become a menace to the existence of civilisation itself.

Indeed, the tree plays an important part in the meteorology of a country. It allows the rains to filter through and restores them slowly to the brooks and to the air. Its leaves and roots are alike obstacles to rapid drainage. The annual mean of atmospheric humidity is about 3·5 per cent more in the forests than in the open country. The denser the foliage the better is the humidity preserved. On the other hand, the pines and the Australian eucalyptus forests serve to diminish excessive moisture in the soil.

The tree not only preserves water, it attracts it. Consequently the rains are more regular, more frequent, and less torrential. Under the shade the soil remains damp during the heat of summer. In Wurtemburg the difference between the temperature of the soil inside and outside forests may be as much as 8° C. Consequently a wind coming from outside is cooled as soon as it reaches the forest, its humidity is concentrated, dew is formed.

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* By Dr. F. Régnault in "La Revue" of 1st March 1904, a subject which has always possessed great interest for me, and one that is of the utmost importance. F. GLEADOW.

For the same reason a cloud passing above a forest lets fall its moisture where it refuses to do so over the open country which reflects the hot rays of the sun.*

The fact has been often observed. A field situated in the open may often be parched while it may be raining for the greater part of the year in the forest. In Malta, since the trees were destroyed for the culture of cotton, there may be no rain for three years together. On the other hand, in St. Helena, reboisement has caused the rainfall to become double what it was in the time of Napoleon. Even in Egypt, recent plantations have induced a rainfall hitherto unknown.

When the deboisement affects only the plains, the harm is not so great. The rivers still flow down from the mountains, and the thirsty valleys can still be watered by means of canals. Thus the Po and the Ganges, which provide for millions of people, descend from wooded mountain masses. Doubtless the climate becomes more variable: the orange trees have disappeared from Languedoc and from Provence where they grew formerly. But on the whole the crops continue to be abundant, thanks to the waters descending from the mountains.

But when the plain is of clay, where the drainage is difficult, the effects of deforestation are felt. The water, no longer sucked up by the trees, lies in stagnant swamps. When the people are also careless and neglectful of their canals and drains, the fever appears, and the population diminishes; for instance the Pontine marshes, the Dombes and Sologne in France. The Dombes began to get swampy in the fifteenth century. Great churches, easily able to hold the whole existing population, bear witness to the former crowding; in like manner the Sologne was formerly wooded and prosperous.

On the other hand, a marshy country is rendered healthy by reboisement. The replanting of the Roman campagna, of the Tuscan marshes, and of the Landes, have destroyed or reduced the former insalubrity of those localities.

When the mountains are bared, all is ruined. The rains are perhaps not much less frequent, but they fall torrentially and flow rapidly off the denuded soil. They carry off first the vegetable soil. The mountain shows its rocky skeleton, the rocks break up, cones of erosion are formed, landslides, gullies, unstable slopes, become so many running sores by which the substance of the mountain is carried down. The rocks offer more or less resistance according to their nature, but none remain firm. Granite splits up into enormous blocks which roll irresistibly down into the valleys. Limestones stand better, but ultimately break up, splitting along numerous parallel lines

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* Numerous works have appeared on this subject. Among these may be quoted as classics Ebermeyer: *Die physikalischen Einwirkungen des Waldes aufu Lfteund Boden*, 1873; and G. Roscher: *Traité d'économie rurale et forestieere*, French translation by Vogel, Paris 1888, octavo.

under the action of the water reaching the inside and the sun heating the outside. It breaks first into great blocks which give the mountains the appearance of great cyclopean structures. Later the blocks disintegrate into small stones that go rolling down the slopes into the plain.

If nature were left alone at this stage she would soon bring back the vegetation. But the mountaineer is there with his sheep and goats; these animals are his only wealth; they finish the work of destruction by tearing out the grass instead of cutting it short, by browsing the young shoots, and by so cutting up the soil with their hoofs that it is easily washed down by rain.

When the highlands are ruined, what becomes of the plain? When the country is exposed to marine currents, it continues to receive rain. Thus the Gulf stream brings moisture to those European countries facing the ocean. But in the contrary case the country suffers from drought.

The river becomes a torrent when it rains, carrying down earth, trees and rocks. Swollen beyond measure, it rises over the plain in a sudden flood, which destroys houses, flocks, villages and people. Plains which receive the waters of wooded mountains are not exempt from floods, but these are slower and their effects very different, for they deposit a layer of fertile slime and may be very useful, like the Nile floods; even the Garonne, when it rises slowly, is a benefactor. The sudden flood is characteristic of denuded countries; it sweeps away the soil, and leaves behind a sea of stones instead.

Now the sky is always blue; the clouds no longer melt on the mountain; the latter can no longer supply the valley with water, for all the water rushed down at once. Now is the time of drought and famine. Irrigation is impossible, for the rivers are dry; one can walk along their stony beds until the next heavy rain brings down another flood. A given river formerly navigable cannot now fill an irrigation canal. The thirsty riverains shoot each other to obtain the water.

The cultivators try to continue the struggle by means of reservoirs and costly dams. The Romans knew this period when they had denuded Africa.* But dams are dangerous, for they often burst. Soon even this resource becomes impossible, and the destruction of the plain follows that of the mountain.

II.

These facts are known of many and have been often quoted. Democritus, Theophrastus, and Seneca mentioned them. Columbus, Leonardo de Vinci, Bernard de Palissy drew attention to them. "I marvel," said the latter, "at the great ignorance of men, who seem now so anxious to break down, cut up, and tear in pieces the beautiful forests that their predecessors had so preciously kept.

* Dr. Trolard: *La Colonisation et la question forestiere.* Algiers, 1891.

I cannot sufficiently detest the thing, and I cannot call it fault, but a curse and a misfortune for all France, because when all the woods shall be cut all the arts must cease."

Later, Buffon wrote eloquently on the subject. Bernardin de St. Pierre wept over Mauritius, which in losing its forests has lost its brooks. In our time the authors are numerous, Valori, Carrière, Bandrillart, Clavé, Eliseé Reclus, Jeannell, &c.; but they are no more hearkened to than Seneca or Leonardo de Vinci; the denudation continues as before.

Great nations have died through not respecting their forests. The careers of Israel, of Assyria, of Greece, of Carthage, and of Rome are ended, but wars alone could not have brought the end. The most frightful disasters fail to destroy peoples. The germ of death was in them. When the crops refuse to grow, when the fields become deserts, then only the people disappear and the nation dies out.

Moses said of Palestine "that it was a country of springs, of brooks, and of lakes, a land of corn, of barley, of vines, and of figs, where man had but to garner in the provisions to satisfy his wants" In the days of Israel's prosperity, crowded multitudes were living on this corner of land. When David numbered the people he found in Israel 1,100,000 adult males, and in Juda 470,000, without counting women and children; Levi and Benjamin were not counted.

Where is now this green land of Palestine and its valiant people? "Mountains without shade, valleys without water, earth without verdure" says Lamartine of the environs of Jerusalem. The trees have disappeared and the people with them.

Let us cross to Arabia. There was a time when she was called Felix, "the Happy," and was full of people. In the inscriptions the Assyriologist may still read descriptions of flourishing nations, "Kindana and Suhi, on the right bank of the Euphrates." The map shows now only deserts where the nomad plants his scattered tents.* Assurbanipal conquered vast cities in Nejd and in the Hedjaz; they are swallowed in the desert. Mariab and Sabota have left gigantic ruins in Yemen. The nomad who camps there will not believe that such edifices were made by human hands. The trees and the towns are gone together.

Nothing astonishes the traveller more than these fragments of immense capital cities found in countries where there exist now neither water nor vegetation. Such instances are numerous; they are found in Turkistan, in Algiers, Tunis, Persia, Pera, &c., as Boppe says, "the denudation must be attributed to man." † In fact, before any region can be reduced to such a condition that it no longer supports a single one of the numerous forest

*Lenormant: *Histoire ancienne*, t. VI., p. 425.

†Boppe: *Traité de Sylviculture*, Paris, 1888. Introduction p. VIII.

species, it must first have become liable to the absence of rain, to incessant torrid heat, and to dry winds blowing with untempered force.

III.

Proof can be obtained by the inverse, or synthetic method. In certain countries it is possible to replant, and by replanting to restore the ancient prosperity. Thus the Americans have transformed the canyons of Colorado and Nebraska, in ancient times inhabited by a numerous population, but later dried up and ruined by the clearance of the forest. These are now an immense orchard.

The French are engaged on a similar task in the plain of Sfax. They are reforming the ancient olive forests. The Arabs, when they destroyed the trees, destroyed thereby the cities whose enormous remains are still to be seen. Thysdrus with its circus and great temple was a town of more than 100,000 inhabitants; Suffleta contained 20 to 25,000, Cilinm 12 to 15,000, Thelepta 50 to 60,000, and great burghs like Bararus, Masclianа, Meneger, Menogesem, Monianium, each had several thousand inhabitants. Between these towns and burghs the remains of villages and isolated farms are disclosed at every step.

When the trees are cut down, man is not the only thing that disappears; the fauna undergoes a corresponding change. It is astonishing to learn that in the neighbourhood of Niniveh there were thick forests in which Thothmes III was hunting elephants 1,700 years before Christ. In Algeria blocks have been discovered bearing Libyan writing, and pictures of the elephant, the giraffe, and the two-horned rhinoceros. The Carthaginians utilised the elephants. Hanno saw them at Cape Spartel, Herodotus saw them to the west of the Lesser Syrtis, Elian saw them between the Atlas and Getulia. Solin mentions them as late as the third century A. D. To-day no elephant could find a living in these regions.

Let us hasten to say that the destruction of forests is not the sole cause of decadence. In certain countries like Babylon, account must be taken of the carelessness of the inhabitants who did not maintain the system of canals. The Euphrates still carries water capable of ensuring rich harvests if the Turks took the trouble to clear canals.

Greek and Roman history provide us with examples of depopulation on which Montesquieu* and others have laid stress, but without realising that the real and fundamental cause was deboisement. Formerly most prosperous and brilliant, Greece is now poor and sparsely inhabited. Formerly she had forests and rivers. Taking Schliemann as our guide to the plain of Argos, we see that it is dominated by Mount Eubœa, whose very name indicates bountiful pastures; to-day it is absolutely bare. Two streams, the Eleutherion and the Asterion, watered the plain;

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* Montesquieu: *Espridesluis*, Book 21, ch. 22.

one supplied the sacred water for the temple, the other watered plants of the same names sacred to Hera. To-day both are dry, except in time of heavy rain. The plain of Argos was celebrated for its horses; in the "Iliad" no less than seven times does Homer praise its magnificent pastures, calling them "ippobotos." The ground is now so dry that even vines and cotton will only grow in the lowest and most fertile parts.* In Greece, names derived from trees are extremely numerous; Carya is the town of walnuts, Valanidia that of certain oaks, Kyparissi that of cypresses, Platanos that of plane-trees. But the trees have disappeared, the mountains are denuded down to the rock, and the rivers are dried up, the Cephisus and Ilisses of Attica are but feeble brooklets.

Here and there may be seen occasional bunches of trees, pines, firs, evergreen oaks, relics of bygone splendour; Samos, formerly covered with forests, has now but a few scanty groves. The Ionian islands alone have kept their verdure, and Zante has 200 souls per square kilometre, whilst Greece has but 30.

The depopulation began as soon as the decadence, and was noted by the Latin authors. Plutarch says "the oracles have ceased because the places where they spoke are destroyed, hardly could 3,000 fighting men be found in Greece at the present time." Strabo says "I will not describe Epirus and its environs, because these parts are utterly deserted. The depopulation, begun long since, still continues, so that the Roman soldiers camp in the abandoned houses."

Italy itself has suffered in the same way. Titus Livius says "*I shall be asked whence the Volscians could have gathered* enough soldiers to go on warring, after being so often defeated. There must have been an infinite people in these regions which to-day would be deserts were it not for a few Roman soldiers and a few slaves." To this day the Appenines are denuded and the Roman campagna is desolate and sterile.

Sardinia is depopulated and unhealthy, but when the Romans took the island, after three centuries of Carthaginian rule, it was rich, flourishing, admirably cultivated, full of towns and inhabitants.†

Nearer home we find the same disasters, though the professed historians give us little but battles and anecdotes. Dalmatia was formerly covered with forests and had 2,000,000 inhabitants. The Venetians destroyed the forests and ruined the country.

But Spain is the country whose rapid and spontaneous fall has been most striking. No country was more flourishing in the sixteenth century under Charles V and Philip II; its European and Colonial possessions were vast, its riches immense, its victories numerous. Yet in the seventeenth century its prosperity and

* Schliemann: *Rècit des recherches et decouvertes faites a "Mycènes et a* Tyrinthe." Translated by Girardin, Paris, 1879, p. 77.

† Lenormant: *Histoire Ancienne*, Vol. VI. p 634.

power all disappeared without any visible shock from within or without. In less than a century Spain declined among the second-rate powers In the seventeenth century, scarcity was the normal state of things in the centre of Spain. In 1664 the President of Castille, followed by the executioner, was requisitioning the provisions which the people of the Madrid campagna were hording up for themselves. In 1680 the workmen of Madrid formed organised bands for the purpose of killing and plundering. In 1699 Stanhope writes " not a day but some are killed in the streets fighting for bread." This state of famine lasted throughout the latter half of the seventeenth century, and probably until the density of population was reduced to the level of the reduced means of subsistence.*

In the beginning of the eighteenth century, the capital, Madrid, fell from 400,000 to 200,000 inhabitants, the whole province of Castille was ruined, Burgos was but a name, Segovia was impoverished. The depopulation was due to famine, and the famine was caused by drought. The Ebro which in Vespasian's time, according to Pliny, was navigable from Varia up to Logrono, was in the time of the Moors only navigable for 15 miles; by the early seventeenth century Tortosa became the limit.

Under Peter the Cruel in 1350 the Guadalquiver was still navigable up to Cordova; Saragossa was a great centre of shipbuilding. In the sixteenth century the Manzanares was navigable almost to Madrid; to-day in ordinary weather a glass of water cannot be had from it. In Arragon, wine is mixed with the sand to make mortar, rather than use water. The huts are built of stones laid in red mortar, for it would be unheard-of sacrilege to use the scantily-dropping water coming from the fountains.†

A journey across Spain makes it easy to realise the cause of this absence of water; the trees have disappeared. Where formerly wheat grew and men were born there is now to be seen nothing but a crop of thin grass so scanty that the few poor flocks of sheep can only exist by continually migrating. Formerly the flocks ravaged the finest provinces, for they belonged to a powerful corporation which forbade all culture in the lands which they overran. Thus the plateau of Castile is now reduced to such a condition of nakedness that, according to the proverb, the travelling lark has to carry its own grain along. Water is absent from several parts of the plateau. Numbers of towns or villages which possess a spring proclaim the joyful fact by their very names. The Central Provinces where life was intense, the link connecting all the peripheral efforts, are become desert. The consequences are not hard to follow. Though the littoral provinces have suffered

* Buckle: *Histoire de la Civilisation en Angleterre en France, en Espagne et en Ecosse.* French translation. Paris, 2nd edition, 1881, Vol. V., p. 16.

† Elisée Reclus. *Histoire d'un ruisseau*, p. 211.

less, thanks to the sea which still supports a numerous population, the heart of the country is paralysed. It is as though, in France, the basin of the Seine were to become nothing but pastures. Hence the depopulation, the impoverishment, and the intellectual decadence.

IV.

In our times decadence is threatening the nations that destroy forests. Comparing the wooded areas of the European states, it is seen that those which are the most wooded are also those which are increasing most rapidly in population and power. While France has barely 16 per cent. of her territory wooded, and Italy has about the same, Russia has about 40 per cent. and Germany 24 per cent.

The latter lay great stress on sylviculture and begrudge no expense for deboisement, distributing plants at cost price to communes, associations and private persons, and granting financial assistance to those who will replant. On the other side, Portugal has only 6 per cent. of her territory under wood, Spain has only 3 per cent, Persia 5 per cent. Let us consider France, which interests us more particularly. Since the days of the *ancien régime* France has lost about half her forests, for Mirabeau, in his 'Theory of Taxation,' estimates them at 17 million hectares, whilst they are at present only 8½ millions, for the greater part coppice and open woods: five or six million hectares of these so-called forests are only scrub of practically no great value. But it will be urged that we have a Forest Administration and wise laws, credits to boot, for deboisement. A perusal of works on Forest Economy will be instructive, for it will reveal the appalling state of dilapidation into which has fallen a component without which civilisation becomes impossible. It will show that the little deboisement done by the administration is largely counterbalanced by the destruction going on all around. Since the foundation of the present administration in 1825, the wooded surface has diminished by 750,000 hectares; the communal forests, covering 1,900,000 hectares, are in a pitiful condition. They are steadily disappearing by three outlets, pasturage, the removal of dead leaves, and special fellings. As to private forests, the owners have destroyed within the last 50 years more than 400,000 hectares, while more than half of those remaining are nothing but wretched scrub which does not pay for its taxes and upkeep. Even the domanial forests are exceedingly difficult to protect from the greedy grip of the electors.

Proceeding to the provinces it is seen that the forests become scantier and scantier towards the south-east. The effects of deboisement are nowhere more apparent than in the Departments of Basses and Haute-Alpes* Formerly those forests were

*M. Maury: *Les Forêts de la Gaule et de l' ancienne France*, Paris, 1867.

protected. In the thirteenth century, according to J. Roman* the citizens of Briançon passed an Ordinance forbidding any fellings in the forest of Pinée, whose disappearance would entail that of several villages. In Dauphiny, at about the same time, Humbert II passed an Ordinance to forbid the cutting of trees along roads; the close relation between roads and forests had been perceived. In the fifteenth century the town of Embrun protested in vain against clearing. These have gone on ever since. Thus the forest of the Gapençais has all but disappeared, Dévolny is perfectly bare, there are no more broad-leaf forests in the Embrunais and the Briançonnais. Places cultivated in the sixteenth century have had to be abandoned in consequence of the increasing severities of climate. The vine has lost territory. In certain localities the roads have been again and again removed to new alignments, but to no purpose. The Durance, navigable in Roman times, no longer carries enough water for the irrigation canals. In the ten years from 1842 to 1852 the cultivated area in the Basses-Alpes decreased from 99,000 to 74,000 hectares. The two departments, which before 1790 had 400,000 people, have now only 280,000. It is the same for the Lozère, which under Louis XIV had 150,000 people, and has now only 144,000. It is the same in Corsica, where clearing is still being actively pushed on.† They are even felling the chestnut trees, whose fruit provides the peasant's only food, because the Germans will buy them to make gallic acid. It is the same in the Pyrenees, the Limousin, &c., &c.

Doubtless the depopulation of France is the result, in a great measure, of voluntary restriction, but deboisement must also be allowed to be a cause, the importance of which is shown by the werk of M. Jeannel. The population-rate diminishes most in the cleared Departments, that is to say, in those where the State has had to undertake the restoration and preservation of the mountains at its own cost. In these Departments, from 1871 to 1891, the increase of population, which should have been about 33 per cent, was at first hardly 16 per cent, and finished up the last quinquennial period with a loss of 89,682 inhabitants,‡ whilst the other Departments showed an increase of 89,682 inhabitants.

During 1891, for all France the deaths exceeded the births by 10,505. The cleared Departments showed a death excess of 11,885, that is to say, they provided the excess-deaths for the whole of France, and 1,880 more deaths into the bargain. For 1892, the death excess for all France was 20,040. To this excess the cleared Departments contributed 16,028, that is to say, out of all proportion. Taking the total population of the various

* Roman: *Sur les causes du deboisement des Montagues.* Gap. 1817.

† D. Donati: *Congrès de l'Association pour l'avancement des Sciences en earse*, 1901, vol. 11, p. 896. This Author reports that the Agricultural Societies and the General Council desired to put a stop to this state of things, but that nothing could be done in face of the rights of property.

‡ Jeannel: *Association pour l'Avancement des Sciences.* Congress at Marseilles, 1891. vol. 11, p. 1021.

Departments, it is seen that in the cleared Departments the deaths have been 1·64 per 1,000, whilst in the others it was only 0·18 per 1,000. Granting that the clearance of mountains must prejudice the plains also, it is clear that since the Departments form our united whole, the effects of deboisement are even more serious than is claimed by M. Jeannel. Statistics show that depopulation works differently in the cleared Departments from what it does in those where voluntary restriction rules. In the latter, the hygienic conditions are good, the expectation of life is high, and deaths are few, but the births are fewer still. On the contrary, in the cleared Departments besides the differences in the birth and death rates emigration comes into account. The people seek elsewhere the food denied them by their own place.

Having studied the effects of deforestment, it is well to seek the causes. They are of various kinds.

The most important is *civilisation itself.* Civilisation increases the sale value of wood, and provides the means of transport without which sales would be very limited. It awakes greed in the mind of the landowner and at the same time allows him to satisfy his greed. Thus the barest countries are always the seats of the oldest civilisations. Certainly, when the landowner finds it to his interest to plant, he does not hesitate to do so. Thus the truffle industry has caused the plantation of more than 60,000 hectares of oaks in Vancluse ; and recently the oil trade has caused the plantation of an immense olive forest round Sfax in Tunis. But such cases are quite exceptional.

The cutting of trees is a source of immediate profit, but it entails later a great diminution of revenues. Hence reboisement meets with great difficulties, not only in the want of money, but in the hostility of the inhabitants. These people were originally hunters, woodmen, petty cultivators, but especially herdsmen, enjoying rich pastures and large herds of cattle. The destruction of the forest forces them to change their livelihood. They become shepherds and goatherds, for these are the only animals which can exist on the soil when it has become impoverished. These animals live on young shoots and buds, and prevent the forest from growing again. The shepherds themselves oppose every attempt at reboisement, pulling up young trees, destroying seedlings, &c., for they fear to lose their living. They even burn the forest in order to obtain further areas, until the mountain disintegrates and their last resources are swept away by landslides and erosion.

The political condition is of great importance. A strong Government enforces respect for the forests. It is thus in Germany. There (they hold it a great mark of distinction) the forest administration organised by the Great Frederic is still feared and obeyed. It used to be the same with us ; Sully, Henri IV, Louis XIV, successfully conserved the forests, which were then rigorously protected. When the Revolution came, every political

shock took effect on the forest. The peasant's most glorious proof of his new-found liberty was to go and fell trees in the State forests. In his History of France, Michelet says "trees were sacrificed for the most trifling uses; two pines would be cut to make a pair of wooden shoes. At the same time the goats and sheep increased and multiplied, took possession of the forest, damaging young trees, devouring young shoots, and destroying all hope for the future." Another author, Ch. Comte, says "I have seen the torrents formed on newly-cleared mountains sweep away not only the soil, but trees, rocks, houses, and spread terror among the valley populations It was the same in 1830, in 1848, and at every violent political change.

What the Revolutions did transitorily is now done permanently by the Parliament-parody which now governs us. The deputies dare not resist their electors for fear of losing their seats. "At present," says L. Tassy,* "no Government has been strong enough to restrain the greed of the communes in the matters of special fellings and dead leaves, to confine the grazing of cattle within proper limits, or to insist upon the expenditure necessary for urgent works and for the due execution of working-plans. Worse still, our masters oppose even the very moderate measures of protection that lie within the power of the forest administration." "How many times," says the same author, "have we not seen conservators disavowed, almost disgraced, because their just indignation at some spreading abuse had driven them to some protective action."

For the most part, the deputies sin in ignorance, for they have never studied anything to fit them for their position. In the political world forest questions are considered of small importance. The law of 4th April, 1882, on the restoration of mountain slopes, relied on the help that might be given by communes and private persons, and whittled down to nothing the powers of the administration responsible for the results. In Algeria, private and communal forests have been created, but the budget of the administration has been reduced. (Budget of 1885 onwards.)

While the State is thus so badly neglecting its duty, all the authors who have studied the subject of deboisement are agreed that the State is the only possible source of salvation. They wish to forbid all clearings by communes or by private persons, and to make the private interest yield to the public good. A despotic Government can indeed enforce blind obedience on the part of its subjects, but in a republic, where every one is a judge and critic of policy, the best laws are useless unless the citizens understand their utility.

The great thing is therefore to spread the truth, which is after all known to very few. When the French come to believe in the

* L. Tassy: *Aménagement des forets.* Paris, 1887. Preface, page XXIV.

Servian proverb " Who kills a tree kills a man," they will unanimously demand laws as strict as those which were so successfully promulgated a few years ago in Switzerland. Such laws would become less necessary if we had some powerful assocations * such as the American " Arbor day," which was founded in 1872, and has in 23 years planted 350 millions of fruit and forest trees in Nebraska alone. The Italian Minister Bacelli has recently followed this good example. He has instituted a holiday for the school childern to plant with due ceremony a tree apiece in the Roman campagna. When shall we do the same!

Notes on Sandal.

(*Continued from page 267 of the Indian Forester.*)

VI.—NATURAL REPRODUCTION.

32. Sandal is a prolific seed-bearer. Its ordinary and general *fruiting season extends from June to September,* but it also bears fruit rather sparsely between November and February. It is not uncommon to find at one and the same time trees laden with flowers and fruit from the nascent tiny flower bud to the ripe fruit ready to drop; this occurs more frequently in trees associated with a number of other species than in those growing isolated or in open scrub.

33. It reproduces itself plentifully from seed and to an appreciable extent from root-suckers also. The general paucity of seedling growth in natural sandal tracts is due to various disturbing causes which come into play *after* rather than *before* germination. I have frequently observed the ground under and round about parent trees carpeted with seedlings, but on subsequent inspection hardly 1 per cent of them were seen alive. This destruction of seedlings is brought about by several causes, the *chief among them being (1) fires, (2) trampling and browsing by cattle and wild animals, (3) exposure to excessive sun and rain,* and (4) *dampness and drip.* It is needless to enter here into a detailed account of these hurtful causes, for they have been fully dealt with by previous writers on the subject.

34. I shall now confine myself to a few observations on the conditions under which natural reproduction is found successful in certain localities on the Javadis.

In February 1903 I noticed a large patch (about 5 acres) of low bushes on the western slope of a ridge overlooking the Chittoor village. A few sandal trees were scattered about this area. On examining the bushes, which consisted of clumps of coppice shoots partially browsed down, I found sandal seedlings

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* There are but four anti-deboisement societies in France; at Nice, the Société des Amis des Arbres des Alpes Maritimes, founded in 1892 by Dr. Jeannal; *the Société Forestiere de la Franche, Compte, and daughter of the* preceding; the Société des Amis des Arbres, founded at Paris in 1895, and the Signe du Reboisement de l'Algerie, founded in 1881 by Dr. Trolard.

varying from 6 months to 3 years of age in almost every bush. All the grasses and other herbaceous growth between the bushes had been close-cropped by the village cattle and the area therefore enjoyed immunity from fire. My own observations and enquiries revealed that this area had been subjected to shifting cultivation (*ponnakáded*) four years previously. The bushes were of coppice re-growth from trees and shrubs felled when the land was brought under cultivation. The sandal seedlings were numerous enough to impress me with the idea that there was at least one on every square yard of the whole area. Even in an artificially-raised plantation, one could not desire a more numerous or more regular distribution of the young plants, all of which looked healthy and the majority vigorous. Adjoining this patch, there is an older *ponnakád* said to have been abandoned about ten years ago. In this area the coppice re-growth is much taller and denser. I found sandal seedlings of different ages in this patch also, but they were not quite so numerous, though sufficient to stock the area with a normal crop of mature trees, provided they escaped destruction by external causes before attaining their exploitable age. Elsewhere also I have observed successful natural reproduction only under similar circumstances.

35. What then are the conditions favourable to sandal reproduction in *ponnákaded* lands which produce such satisfactory results? Such an inquiry cannot fail to be instructive and interesting, and to my mind the following are among the most important conditions that favour natural reproduction in such lands:—

1. The worked-up and friable condition of the soil serves as a good seed-bed and facilitates germination of sandal seed.

2. The lateral roots of existing sandal trees, if any, are exposed and injured during the process of tillage and root-suckers shoot at all injured points, thus supplementing the young crop of seedlings in stocking the area.

3. The young coppice bushes protect the tender seedlings against cattle and wild animals, and shelter them from the injurious effects of the sun, rain, and violent winds.

4. The young and vigorous roots of the coppice growth enable the tender sandal to draw its nourishment from them by forming root attachments. That this is really the case has been established beyond doubt by Mr. Barber's investigations and amply confirmed by my own subsequent observations. I am inclined to attach the greatest importance to this factor, because it enables the sandal to grow vigorously from the very commencement and to establish itself firmly in the soil, thus acquiring a capacity to withstand injury, which a seedling unattached to other plants can never hope to possess or acquire.

5. Immunity from fire which the seedlings enjoy, chiefly due to depasturing by cattle and partially to the obstruction that the coppice bushes themselves present to the advancing fire.

6. Admission of light and air to the seedlings and to the soil with *sufficient protection* that the coppice bushes afford against the scorching rays of the sun. This is rendered possible by the free roaming of cattle, which prevents the interlacing of the coppice bushes which would otherwise form a dense lateral cover. This free play of air and light not only benefits the sandal seedlings directly, but also prevents their damping off by *encouraging evaporation* of any *excessive* moisture in the soil.

7. As goats are not excluded from such unreserved lands, it is possible that they nibble off the succulent tops and branches of the young coppice shoots, thus preventing choking and suppression of the tender sandal by overhead cover of the coppice bushes. This may at the outset be beneficial to the young sandal, *although the evil* effects of goat browsing might eventually prove disastrous to it at a later stage of growth.

36. It may be asked whether the admission of cattle and goats into sandal tracts does not cause infinitely more harm directly to the sandal than the very small indirect service it renders. While admitting that it does so the *admission of cattle* may be disadvantageous, I do not hesitate to record my conviction that where really successful fire protection is impracticable, the intrusion of cattle may make it possible, and sandal seedlings may therefore be saved which otherwise would be destroyed. It is perhaps a case of choosing the lesser of two evils, but as previous writers on sandal have forcibly stated, *of all the enemies that sandal* has to contend with, *fire* is the worst and the most dangerous. It not only annihilates seeds and seedlings, but also kills grown up saplings and even mature trees. Some years ago I inspected a fire-protected area in which sandal trees of 2 to 2½ feet girth were growing vigorously. An incendiary set fire to it; I inspected it immediately the fire *occurrence was reported* and again a year after. At the latter inspection I found almost every one of the trees had died after a feeble attempt on the part of a few to send out a few miserable shoots at the base which had also withered, while naturally all the younger sandal growth had been destroyed completely. Domestic cattle, assisted even by goats, could not *have succeeded even after ten years of* free access to the area in destroying sandal so completely as a single fire had done in the course of a few hours!

37. Before proceeding to discuss the question as to what extent and with what modifications the methods adopted by nature in reproducing sandal in *ponnakáded* areas may be followed in *regenerating that species, I propose to* make a short digression by way of a brief enquiry into the possible conditions under which our existing sandal areas could have come to be stocked with it. In dealing with this subject, I shall base my remarks chiefly on information gathered by direct observation and study of the sandal tracts on the Javadis and Yelagiris and *by making enquiries* of the inhabitants of these hills.

38. Where do we find the bulk of natural sandal on these hills? We find it not in the virgin forests of which we have still a few small remnants here and there, not in the luxuriant evergreen sholas which grace the highest peaks, nor in the heart of massive forest blocks away from human habitations; we do not even find it on forest land in the proximity of such habitations, unless it has been tilled once by the hand of man. In fact it is found only on lands cleared, cultivated and then abandoned to relapse into their primitive sylvan state. Trees of the species are found in appreciable numbers on the following classes of lands:—

(1) Lands now under cultivation. On such they are few and scattered.

(2) Hedges of cultivated lands.

(3) Old fields abandoned comparatively recently and on which young scrub has come up.

(4) On forest lands subjected to shifting cultivation for two or three years and then left to reclothe themselves with vegetation. We have such lands of all ages, and it is on the older of them that we find abundance of sandal trees in all stages of growth. These comprise the largest and the best sandal areas on the Javadis and Yelagiris.

(5) Narrow belts of forest reserve hardly exceeding a furlong in width and bordering on the above four classes of lands. Such belts are sparsely stocked with sandal which must have spread from the cultivated lands very slowly and gradually.

39. In the interior of dense forests, whether evergreen or deciduous or even scrub, we find little or no sandal. Where isolated patches of it exist in such localities far and away from existing villages, enquiries and observation have satisfied me that those patches were once the sites of deserted villages or abandoned cultivation. Such, for instance, are the sandal patches of Mundapatti and Settipatti on the Javadis. From the articles and reports of Messrs. Pigot, MacCarthy, Ricketts, Colonel Walker, P. M. Lushington and others that have appeared from time to time in the *Indian Forester* and elsewhere, it is to be gathered that in all provinces and districts in which it is found natural growth of sandal is confined mainly, if not entirely, to the same descriptions of lands as those on which it is found on the Javadis and Yelagiris.

40. The foregoing remarks naturally suggest the following two questions: (1) Why does not sandal occur in dense forests high or low? and (2) why does it confine itself to lands once under cultivation or to their immediate neighbourhood? I have already in this article attempted an answer to the *second* question, and shall therefore pass on to a brief consideration of the former. In natural dense forests, the leaf canopy being complete, (1) sandal seeds and seedlings are deprived of the free circulation of air and sunlight which are essential for the germination and growth

of the seedlings; (2) the soil being covered with a more or less thick layer of decaying leaves and twigs is very moist and cold, and consequently seeds and seedlings are damped off and killed; (3) such of the seedlings as survive or escape dampness and drip are suppressed by the overhead cover; (4) there being generally an absence of bushy undergrowth in canopied forests, the seedlings are exposed to trampling and browsing by cattle and wild animals; (5) when seedlings make head in spite of the above causes, they are destroyed by fires which occur almost annually; (6) it is also probable that the absence of an adequate and suitable undergrowth deprives the young sandal of the chance of forming sufficient root connections with other species and thereby of acquiring the requisite vigour and power for it to hold its own in the struggle for existence.

41. In open forests also sandal is absent, because, *firstly*, the soil being hard, dry and impervious by exposure to sun and rain and constant tread of cattle, does not give suitable lodgment for the seed; *secondly*, the delicate seedlings that may come up succumb to the influence of the tropical sun; *thirdly*, the occurrence of fires in such forests is more frequent and destructive owing to the dense growth of grass and other rank vegetation; *fourthly*, the hardness of the soil retards and checks the rapid development of its root system, and consequently the *formation of adequate root attachments with other species*. These causes, among others, are I think sufficient to explain the absence of sandal in natural forests.

42. In spite of the unfavourable factors mentioned above, it may be broadly stated that the area under natural sandal has been slowly and gradually extending itself in narrow belts along the fringes of old sandal tracts. We have clear evidence of this in the Denkanikotta sandal tracts of the North Salem Division. These tracts, as they then existed in isolated patches, were indicated on a stock-map prepared under the direction and supervision of Colonel Campbell Walker in the year 1869. We now find the areas between those patches fairly stocked with sandal. This process of natural spread of the species is no doubt very slow, but considering that it has had to contend with so many adverse influences, the progress it has made within the past 35 years appears hopeful and encouraging.

43. I now come to the question how best can we aid and foster the natural reproduction of sandal? I would suggest our following nature in her methods of reproducing it in *ponnakáded* areas as described in previous paragraphs I would select lands wooded with species other than sandal and valuable timber trees such as teak, black wood, and kino (*Pterocarpus marsuium*) within its natural habitat and allow them to be *ponnakáded* for a year or two, taking care to leave uncut as many trees of the species much preyed upon by sandal roots as may be compatible with sufficient admission of light and

air to the ground below and the avoidance of drip. When the cultivation is abandoned at the end of the first or second year, clumps of coppice come up from the cut stools of trees and shrubs. Sandal seeds shed by trees standing on the lands or brought by birds from outside find lodgment in the coppice clumps and soon germinate and grow up under their shelter. Where the land is not naturally sown with sandal sufficiently by the above process, I would dibble in the seed amongst the clumps in June or July at the first burst of the south-west monsoon. If the areas thus sown are within managable limits, they may be protected from cattle and fire. But if the growth of grass is high and dense and there is danger of the young sandal being choked, I would allow light grazing in order to reduce the grass; this no doubt may cause some damage to the sandal seedlings, yet it will be less than the damage by choking, especially as the coppice clumps protect them from the bite of cattle. Of course, goats must be altogether excluded. The sandal seedlings will establish themselves quickly by the development of their root system which is facilitated by the friable condition of the soil, and by the formation of root-attachments with other species. If the coppice shoots threaten to suppress the sandal seedlings by forming overhead cover, they may have to be lopped to leave the growing crowns of the sandal free. In the course of seven or eight years sandal grows beyond the reach of cattle, which may then be more freely admitted. Of course the areas must be protected rigidly and *successfully* from fire; where this is not possible it is better to allow grass and herbaceous growth round the sandal to be close-cropped by free admission of cattle from the very commencement. In open and bare lands natural reproduction will be successful only when they are covered up with shrubs and bushes, whose shelter and hospitality are so essential to the growth of the sandal seedlings. Therefore in such lands we must foster the growth of other plants which are its favourite posts before we attempt regeneration of sandal by natural means.

44. To my mind the above method of natural regeneration of sandal is the simplest and the cheapest. When the same process is taking place in nature so successfully, I see no reason to doubt its success if carried out by man. Within the natural habitat of sandal we have large areas of forest land stocked with soft wooded and inferior species which yield little or no revenue. We cannot utilize such lands for any better purpose than that of growing this valuable species which gives the largest money-return as compared with that of any other forest timber tree. In undertaking this method of natural regeneration it is better and safer to take up small areas and to carry out the operation efficiently rather than to undertake it on a large scale, which might be unmanagable, and therefore unsuccessful in its results.

(*To be continued.*)

Salem. M. RAMA RAO.

Sound Advice from Bombay.

In the *Indian Forester* for last February amongst the Miscellanea there is an extract with the above heading. The extract would have been more truly described if it had been headed "Unsound Advice from Bombay."

The extract is taken from the remarks made by Mr. F. S. P. Lely, Commissioner, Northern Division, Bombay, in forwarding to Government the Annual Report of the Conservator, Northern Circle, for 1901-02, and I venture to say that the remarks show an entire lack of appreciation of the nature of forest operations. The Commissioner opines that the nurseries in the Northern Circle are all based on a wrong principle, because "they are merely plots where seedlings of such trees as teak and tanach (*Ougenia dalbergoides*,) are reared and then transplanted to sections of forest area which must be of limited size even for the produce of a big nursery." Now, if by sections of forest area Mr. Lely had meant "blanks in forest" his descriptions would have been accurate enough. But from what he goes on to remark it is evident that such was not his idea and he falls foul with the rearing of "teak and tanach," because the Forest Officer ought in his opinion to be experimenting with exotic plants and less known species. The object of the nurseries which are maintained in the Northern Circle is the raising of plants that are indigenous to the country, and those species are selected which grow best, will best bear transplantation and give the best results in timber, and surely this is true forester's work. The plants reared in the nurseries are not confined to teak and tanach as Mr. Lely alliteratively suggests, but include teak, various species of terminalia, bassia latifolia, acacia catechu, &c., &c., and they are intended for the filling up of blanks and not for the reafforestation of large areas, since such a work is too big to be attempted with the funds placed ordinarily at the Divisional Forest Officer's disposal. But Mr. Lely considers in his wisdom that "this method would be well enough for a private landholder who wanted to put a few hundred of acres under timber, but the Government forests are far too extensive to be treated as mere plantations." This airy reference to the private landholder would lead one to suspect that this individual

was in the habit of making plantations on his lands, but we all know that such unfortunately is far from the case, and Mr. Lely might preach to him about plantations with more advantage *than to Forest Officers. He goes on to say that "the ordinary* trees of the country should, it would seem, be regenerated by assisting natural reproduction and by direct sowing." Does Mr. Lely really think that Forest Officers do not in Bombay practice the first principles of forestry, or is it merely that having mastered the meaning of a few technical words he wishes to air his small knowledge? As for his recommendation of direct sowing he should, in the course of his long service in forest districts of the Bombay Presidency, have learnt by this time that direct sowing on bare tracts has been attempted "ad nauseam" and that nothing has resulted therefrom but weariness of spirit.

But Mr. Lely does more than merely criticise the Northern Circle forest nurseries. He gives us his ideas of what the *nurseries should really be. He says they should be "central"* for each Division "if possible at head-quarters and under the personal care of the Divisional Officer." But in this he is not original. The forest nursery at Godhra in the Panch Mahals Division is exactly of that description. "It should gradually take on the character of an experimental garden, where new products *are being constantly tried* and diseases and pests and other problems of interest being studied as far as may be." It should "also contain in time a complete collection of specimens of such of the forest products of the Division as can be turned to the use of man both in the living plant and in the form suitable for commerce." Why, the Dehra Dun Forest School Museum and Garden would apparently not bear comparison with one of Mr. Lely's central nurseries! According to Mr. Lely the expense of keeping up such a nursery is not worth mentioning; it can be looked after by the Divisional Forest Officer as part of his ordinary work, though how this is to be done when it is considered that the said officer can only be in headquarters for five months out of the year, is not explained. What Mr. Lely wants is a Botanical *Garden, Museum and Laboratory, all maintained by one Forest* Officer, in each division of the Presidency. And for what purpose? Simply in order that "a stranger on entering a district, whether bent on science or business, would find ready means of learning what the forest can produce!" Does Mr. Lely think that because mahogany trees, eucalyptus, sal and our old friend Pethecolobium sainan can be raised from seed and made to maintain a struggling existence in a district to which they are not suited, that therefore these trees are interesting as showing what the forest can produce. Is not a fine crop of healthy teak and tanach seedlings growing freely a far more inspiriting sight than such abnormalities? Let his problematical stranger go to the Botanical Gardens at Bombay or Poona, and to the *Dehra Dun Museum, when bent on science or business or*

both, or if he comes to a Forest Officer's headquarters, let him be prepared to spend a short time in the district and be taken into the forest and shown forest products "au naturel;" he will learn more and it will cost Government nothing.

I have only a little more to say about Mr. Lely's remarks. He likens Forest Reports to the "accounts of a timber merchant in a huge way of business who devotes himself to growing teak and bamboos and selling off his stocks at the best possible price." This is mere verbiage. Has Mr. Lely ever met or heard of a timber merchant who grew anything? The comparison is so absolutely inept that it is not worth discussion. Forest Reports, *pace* Mr. Lely, do show advance yearly, and the consciousness of further advance being required, but Conservators are confined to twenty pages of print for their reports and ordered to omit new suggestions or possible contentious matter since such are out of place in an Annual Progress Report. The combined effect of these orders is that reports are somewhat dry reading, and it is therefore not difficult to make carping remarks about them. Then Mr. Lely attacks the Forest Department because "not much effort is made to meet the demands of industries that have established themselves if off the beaten track," and quotes the match-making industry which "needs a certain class of wood which will be exhausted in a very short time, but no attempts to keep up the supply have been heard of." The "certain kind of wood" is Bombax malabaricum. Will it surprise Mr. Lely to hear that the match-makers refuse to pay Government a higher rate than 2 annas per cart load for taking this wood from forest? And does Mr. Lely think that it would be profitable to Government to undertake the growth of this wood for subsequent sale at such a price? I think it must be admitted that the Forest Officers of the North Circle, Bombay, are doing better work in fostering the growth of Mr. Lely's despised teak and tanach.

G. P. M.

Reproduction of Teak in Bamboo Forests in Lower Burma.

In an article on page 51 of the February number of the *Indian Forester* Mr. H. C. Walker appeals to Forest Officers in Burma to record their views as to the best means of supplementing the natural regeneration of teak by artificial means. He complains that "Senior Officers" hold views on the subject which appear to him "contradictory, although dealing with fundamental points," and is also apparently indignant with the Forest Department in Burma for not having finally decided which is the best method to attain the desired end, ignoring the fact that the best method in one locality may prove a failure in another.

He informs us that the extraction of a large number of seed-bearing teak *must* (the italics are mine) result in a decrease of natural regeneration of teak. This is obviously incorrect. If

only mature trees are felled, and if these are judiciously selected, we are improving our forests by the removal of such trees and favouring the reproduction of the species. Of course if all teak seed-bearers were removed, reproduction of teak would cease, and the consequences would be serious both for the teak and for the officer responsible.

Mr. Walker's objections to teak taungya plantations are briefly the following:—

(1) The growing stock has to be sacrificed.

(2) They involve so much labour that other more useful work is neglected.

(3) Artificial conditions *unsuited to teak* are created "proved by the fact that without weeding no teak survive."

(4) They form breeding grounds for *Hybloea puera* and centres of contagion.

To these objections the following replies may be worthy his consideration:—

(1) If the growing stock were of sufficient value it would be extracted and sold. But on sites selected for teak taungyas the growing stock would not repay cost of extraction.

(2) First it is necessary to prove that other work is more useful.

(3) This argument will not "hold good water." In virgin forests *natural* conditions unsuited to teak are to be met with everywhere. We see a young teak suppressed for 20 years until nature comes to the relief and the dominating trees die.

Does Mr. Walker consider that all methods of artificial regeneration are to be condemned if they require more than one initial operation? If we manure a potato field it may produce more weeds, but, if the increase in value of the potatoes exceeds the cost of manuring and weeding, is it not sound policy to manure the field?

(4) *Hybloea puera* is probably a serious pest in plantations themselves, but until proof to the contrary is forthcoming it is conceivable that they form "concentration camps" and not centres of contagion.

Such theorizing will not settle the question of teak taungya plantations.

In time it will be possible to collect sufficient data for calculating the percentage such plantations if properly managed yield on outlay, and if it is found that they do not pay, they will not be extended.

In discussing Wathon Plantations Mr. Walker, ignoring the fact that the soil on which kyathaungwa is found is peculiarly suited to teak, takes his brother officers to task for not having accumulated "data for a cut and dried scheme when the kyathaung flowers" based on experiments made when other bamboos flower. Is it safe to argue that, because myinwathon plantations in Prome have proved a failure, kyathaungwathon

plantations are likewise doomed to suffer a similar fate? It would be interesting to know whether in the Prome plantations the bamboos were felled and burnt before the seed ripened or after.

Mr. Walker sets up a dummy "official theory" that "natural regeneration of teak corresponds with the flowering of the bamboo," and proceeds to demolish it with considerable acumen. Most Forest Officers who have worked in teak forests in Burma know that suppressed teak of all ages is not infrequently found under the lofty shade of kyathaungwa, and even occasionally succeeds in piercing its canopy, and one can hardly walk a mile in Myinwa teak forest, in which the bamboo is approaching maturity, without finding scores of young teak under older bamboo.

Mr. Walker discusses the "theory" that suppressed teak under bamboo survives when the bamboo flowers and dies, and competes successfully with the young bamboo growth that springs up. He says "there are several objections to this theory and no methods based on it." His meaning is obscure. If he means that the "theory" is incorrect and that no teak survives, it seems doubtful whether many Forest Officers in Burma will agree with him. It would obviously be difficult to select areas for the establishment artificially of such advance growth, as although we know the flowering periods of many species of bamboos, *we rarely can ascertain when they last flowered in any particular locality in Burma.*

Mr. Walker describes what he considers to be the best method of supplementing natural regeneration of teak by artificial means at considerable length, and apparently would recommend its adoption in all bamboo forests (where teak is indigenous) regardless of the locality. His method may be described as dibbling assisted by improvement fellings. He does not claim to have invented the method, which he says dates from "the earliest times when forestry was first taken up in Burma;" but he complains that the method "has not yet been brought to a high pitch of perfection." It is difficult to see in what way Mr. Walker's theories, if reduced to practice, would differ from similar operations carried out for several years in Burma. The varied nature of the forests in which such operations are carried out makes it almost impossible to lay down rules except on the broadest lines. The usual method is to take advantage of all natural gaps for dibbling teak and to create others artificially by felling and lopping inferior species. Mr. Walker has probably superintended such operations while in the Prome and Tharrawaddy Divisions, and it would be interesting to know what were the results of his methods.

Finally, I would thank Mr. Walker for his interesting article, but might an admirer of his courage in publishing his views suggest that the value of his article would not be impaired if he omitted general statements suitable for test books for beginners, *e.g.*, "Problems of light and shade as they affect tree-growth require careful observation. On a typical sample plot......" *ad nauseam.*

I cannot claim to be a "Forest Officer of experience," but if I have succeeded in setting Mr Walker's mind at rest on one or two points, I feel I shall not have usurped your valuable space in vain.

BASSEIN:
15th May 1904.

L. C. DAVIS.

The Afforesation of Great Britain.

Mr. Stebbing's letter on the subject seems to me more forceful than illuminating. The subject is one I pretend to no intimate knowledge of, but take some interest in professionally and from hearing it recently so much discussed at Home.

The majority of the House of Commons are very practical men, and I believe among the land-owning class, which form the majority, a good deal of interest is taken on the subject. I fear that Mr. Keir-Hardie's proposals, however practical they may seem to Mr. Stebbing, hardly appealed to the commonsense of the House.

Re-afforestation is generally admitted to be an excellent policy, but there are important questions of ways and means which have to be considered before the policy can be adopted.

If you were to consult the proposer, the practicability of his scheme would be exemplified by an increase of the income tax to meet the cost of his proposal, which I think has less reference to the need of forests than to the need of the working man.

Personally I doubt very much whether afforestation would affect the problem of the unemployed. The garden of England may have charms for the London loafer in September, but "the long winter months" is quite another thing.

I know the country better than the town, and there is scarcely a place I know in it where labour is not to be had for the asking. The trouble is that nobody asks for it.

What Mr. Stebbing describes as the two great fallacies in Mr. Long's argument, seems to me to have some germs of sense.

No afforestation on a large scale ever has been attempted in Great Britain, and the fact that Great Britain has therefore been very foolish and will pay heavily for its folly does not dispose of the difficulties in the way.

It has also been the custom to leave remunerative works in Great Britain to private enterprise, and it will not relieve Mr. Long's difficulties to learn that in India this is not the case.

Retired Indian Forest Officers could doubtless bring much useful experience toward the solution of the question, but it is money more than experience that is wanted, and retired Indian Forest Officers are in that respect seldom a valuable asset.

On the whole, however, I agree with Mr. Stebbing that Mr. Long's answer goes deeper and is more serious than Mr. Keir-Hardie's question necessitated.

S. C.

A Method of Killing Padouk.

Some of your readers might be able to confirm the following curious method of killing Padouk. I have not yet caught an offender or tried it experimentally :—

In this and the neighbouring districts there is a great demand for Padouk of from 2 to 3 feet girth to make naves, and I had always wondered how there were enough naturally dead trees of this girth to supply the demand, no licenses being issued for green trees. The other day I was informed that if a splinter of Thitsi (*Melanorhoea sp.*) was driven into the heart of a Padouk, the latter would lose its bark in a month or so and die, apparently naturally. As all the projecting parts of the splinter would be cut off, the cause of death would be almost unnoticeable. This method is said to be well known to all the traders, and if true, accounts for the number of dead trees.

My informant also told me that there was some recent method of killing teak, but this was not generally known, and he had not found out what it was. It would be a useful piece of information if any one could supply it.

SHWEBO :
19*th May* 1904.

H. CARTER.

Eugenia occidentalis.

The following should be added to the description of *Eugenia occidentalis* figured and described in the May number of the *Indian Forester* :—

"It was provisionally placed under *E. polypetala*, Wight, a tree from Chittagong and Burma, from which it differs by the fewer petals and the absence of bracteoles at the base of the calyx-tube."

QUILON :
25th May 1904.

T. F. BOURDILLON.

Provision for the Employment of Forest Officers on Foreign Service.

In the reorganization scheme of 1891 three appointments were included in the cadre of the Imperial Forest Service to provide for the deputation of officers on foreign service, and in 1901 two additional cadre appointments were sanctioned. Of late, the demands on the Forest staff for foreign service have increased, and, on the recommendation of the Governor-General in Council, four additional cadre appointments, thus raising the number temporarily to nine in all, have now been sanctioned by His Majesty's Secretary of State for a period of five years only, from the 4th April 1904, before the end of which period a further report is to be submitted. The additions will be made in the

lowest grade; and should the full number of *officers allowed for* foreign service not be so employed, the officers in excess will be *shown as supernumeraries.* When deputations are made the officers actually deputed will, as heretofore, be seconded on their own provincial lists, and the supernumeraries will be absorbed in the course of the *provisionally substantive promotions.* Arrangements have been made for the recruitment of two candidates in *each of the years* 1904 and 1905, in addition to the ordinary number of eight recruits.

V.—SHIKAR AND TRAVEL.

A Digression and an Incident.

The *Indian Forester* includes "Shikar" among the topics to which its pages are devoted, and a stranger finding a volume in his hands for the first time would surely be surprised not to find a fair share of each month's issue claimed by what he would rightly suppose to be the Forest Officer's principal recreation. Yet it is but seldom that a "shikar" contribution finds its way into the *Forester*. This is presumably due to a general recognition of the fact that "shikar," although the best and most absorbing of sports, is apt to make the very dullest reading that can be found; unless indeed the events described are quite out of the ordinary run or the writer has the special knowledge of his subject and that gift of the few which have made a few "shikar" books so fascinating. Too often the "shikari" who rushes into print is a novice in the first glory of his first tiger, a hopeless egotist or one paid by the column to fill up the pages of the "Field," whose thrilling descriptions are only surpassed by accounts of football matches played by unknown players at unknown places. How well do we know those closely printed lines describing for the 'n^{th}' time the camp, the shikaris, the 'khabar' (generally spelt kubher), the line of elephants, the stops, the tiffin, the moving grass, finally the death or escape of the mighty 'stripes' himself or the more wily 'spots.' Occasionally the literary sportsman, to give his expeditions a greater air of the real thing, will entertain us with a long account of a blank day.

Thus if the meagreness of the "Forester" as regards "shikar" is sometimes a matter for regret, it is also something to be thankful for, and it is therefore with considerable diffidence that I narrate an incident of recent occurrence, in the hope that its comic side may be its excuse, and that it will encourage all sitters in machans to sit on, however hopeless the outlook.

McEluire and I were in camp together. I must not omit to state that McEluire is one of those of whom we stand in awe vulgarly known as a "boss." We were busily engaged one morning after breakfast in the pursuit of the flying docket, when a shikari, not in our employ, came in to announce that two cows had been killed from the same herd about seven miles away. His informant was a simple-minded herdsman whom we found on the spot on our arrival and who conducted us at once, a short distance among dense undergrowth, to a very promising looking kill, evidently that of a tiger. It had been recently killed, a small portion had been eaten, and it was excellently hidden. There, in a good position, at about 3-30 P.M., McEluire was established. The shikari had come away too quickly to fully investigate the story of the simple-minded one, and for our next move we were entirely dependent on the latter. On being asked to disclose the second

kill he showed a suspicious vagueness, but urged on by the others he set forth to find it. We wandered along for a considerable distance, getting vaguer and vaguer, until at last it became evident that our guide was going nowhere in particular, and we came to a stop. The "shikaris" took the herdsman outside the forest so that he might take a general view of the situation and endeavour to recollect something. After a prolonged interval they returned with the statement that they had found the kill, and again we proceeded a long way in what I perceived must be more or less the direction in which we had come. I was on the point of giving up for fear of spoiling sport, when we came on the kill, a thing of loose skin and bones, eyed greedily by vultures from surrounding trees. Having come so far I determined to pass the time till dark by sitting over this untempting morsel (I speak from the tiger's point of view too), so a machan was quickly tied up, and by 4-45 I was sitting quietly watching the vultures and wishing it was time to go. So I sat for some three-quarters of an hour, when a deafening report seemed to come from just behind my ear. I jumped as if the bullet had hit me, and for a second wondered if my rifle had gone off. Looking round I saw a small puff of smoke hovering over a tree not 20 yards away! Soon I heard the movements of a heavy animal, then two more shots, and then a shout from McEluire that the tiger was dead. McEluire had of course seen and heard my return and installation, and his thoughts were bitter, but he wisely elected to keep quiet and see the matter through, though hope was all but dead.

Whether the vulture-eaten cow was really the second kill or an older one, how it was that we did not see the vultures on our first arrival, and whether there really ever was a second kill of the same date as the first, are points which were never settled.

SOHELWA.

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Proportionate Fellings in Sal Forests.

A THEORY, SOME SUGGESTIONS, AND A METHOD.

I. WE have followed the series of articles which appeared some time ago in the "Indian Forester" with interest, and are now encouraged to add our quota, not with any idea that we are offering the solution to the problem by any means, but in the hope that our suggestions, such as they are, may serve as a means to that end, and in the belief that our theory is at least arguable, though doubtless many kind critics will speedily show it to be as untenable as its predecessors.

Taking certain Indian working plans as our starting-point, it seems to us that in many cases their great defect lies in the fact that they have an unstable basis, and that too often an elaborate system is drawn up which rests on the very shallowest foundations, super-imposed on the most hyperthetical of grounds.

In other words, they start to deal with an abnormal forest almost invariably, and end almost as invariably by leaving it only a few degrees, if at all, less abnormal at the end of a period or a rotation than it was before.

This is due to several errors, the initial one, we would suggest, being often the want of a definite objective, and the failure to institute any real comparison between the actual and normal growing stocks of a forest.

It requires little demonstration to show that in ninety-nine cases out of a hundred a work commenced with no definite aim is bound to be a failure. This, we contend, is their position.

The remedy, theoretically, is simple. Our one aim to be kept always in view should be the gradual creation of a normal, in place of the present abnormal, growing-stock. That no working plan can theoretically be sound which fails to institute a comparison of some kind between the actual and normal growing-stocks of a forest, is we take it an indisputable axiom.

This comparison should form the basis of everything, and it is on it alone that the future of the forest rests. We all know and recognise the forester's three great maxims or ideals, the creation of a normal growing-stock, a sustained annual final yield, and the utilization of the annual increment; but too often,

while our intention is to remember them, we forget or ignore them. The *first* represents the desirable but unattainable, being of necessity idealistic, and we must content overselves with a good imitation of the real thing, preferably as "made in Germany."

The *second* is attainable, but not always desirable, while the *third* is both desirable and attainable.

We say the second is attainable but not always advisable, since we shall often be called upon to decide the respective claims of sylviculture and finance in this respect, and it is as well to approach such questions in a broad-minded way, when we may reasonably hope to effect an honourable compromise if nothing more.

With regard to the third we should not forget that "the increment alone renders the growing-stock an active capital," and while removal of too much is worse than removal of too little, both are heinous crimes.

Even here there can be no hard and fast rule. Circumstance must be our master; and while on one hand we may be called upon to cut over woods showing a poor increment, so as to replace them as soon as possible with more vigorous growth, on the other we must beware of cutting over vigorous woods prematurely, nor must we retard cutting incompletely stocked woods for sentimental reasons.

This brings us to the question of Normal Growing-stock, and how best to attain to it or thereabouts is the problem we set before ourselves in this article.

Now with regard to our first object of management, the creation of a normal growing-stock, we would draw attention to the fact that the latter, while valuable as a means to judge the capacity of a forest to yield a fixed return for a certain period of time, is not absolutely essential to know, or at any rate not more than approximately. Indeed, it is not even desirable to know it, if we intend to take it too seriously and as anything except a useful theoretical guide.

For, provided we can maintain the normal increment or render the abnormal increment normal, and establish a normal series of girth-gradations, the growing-stock must automatically fall into line with other conditions and itself become normal.

Hence our direct affair is with abnormal increments and girth-gradations.

Indeed, were we blindly to follow the dictates of a numerical or volumetric normal growing-stock, we might soon find ourselves at an *impasse*, as it is possible, to take an extreme case, to have the normal growing-stock on the ground as a whole as far as volume or numbers are concerned, and still not have the proper proportion of mature trees—indeed, there need not be a single mature tree on the ground the deficit in which in any class is made up for and compensated by excess in the lower classes.

Hence let us not put too great a trust in "normal growing-stocks."

But that it is a useful guide is undeniable.

Then, with regard to our second object of management (a sustained annual yield). At present what is the case? Most working plans successfully burke the question by practically saying "Sufficient unto the day is the evil thereof." They arrange for a more or less sustained annual yield for the first period, of perhaps twenty years, and rest content.

Perhaps they go so far as to hope that at the end of the period the growing-stock will have generally improved, or say in a non-committal way they "expect so many trees of each of the upper classes will be on the ground." At best they successfully prevent over-exploitation and in their eagerness to do what is right forget the opposite but none the less insidious evil, that of under-cutting.

Over-cutting has been long a forestry shibboleth, and with reason enough, since ever since the Forest Department was started almost, we have been fighting to prevent it and to re-establish forests partially or wholly ruined by too heavy fellings in the past.

Many ingenious checks to over-exploitation have been devised, such as to fix the area of the annual coupe or the maximum number of trees to be felled. But these were not enough, and we were compelled to fix a certain minimum girth, below which no tree could be cut, when, by dividing the total number of first-class trees by the number of years required to replace them, we obtained the maximum number of trees it was permissible to fell annually.

Theoretically, again, this is correct, but in practice it would be likely to result in an infringement of our second object of management, and would mean a fluctuating yield.

To avoid this we may resort to the artifice of sub-periodic blocks, and so arrange these as to give us as nearly as possible an equalised annual or sub-periodic final yield. If we wish to go a step farther we may try and combine this with more or less annual sub-periodic coupes, but this is merely a matter for convenience while the former is necessary.

If an area check is adopted, it should give minimum and maximum areas of annual coupes to allow of elasticity in felling, within sub-periodic limits, to meet possible fluctuations of the market. This is where our working plans too often fail. With commendable dexterity and foresight, and often by means of weird formulæ or figures, they successfully prevent any fear of over-cutting and consider, when they have taken out all first class exploitable trees within the period, whether more or less than the normal number, they have done all that is required of them.

But what about the proportion or percentage of trees in each class which never for various reasons attain to the next higher class, the forest drones?

Again, what about possible surplus growing-stock? Unless we take steps to remove these superfluities of the forest, which are likely, too, to prove a remarkably powerful asset at times, we are under-cutting.

There is, too, the converse, where we have a deficient growing-stock and annual increment.

Here proper nursing is required to restore the normal growth. Hence we see at once that some comparison between normal and actual growing-stocks becomes absolutely essential; and at present so far as we know no such comparison exists.

But our present concern is with the superfluous quantities. What are they doing at present? Simply decaying or occupying space that might be utilised better to give much required light and crown-freedom to others, to relieve over-congested parts, and to make room for more promising individuals. By not utilising them we are tying up our capital, losing legitimate interest.

But how are we to know what trees to remove? We cannot hope to point out each invididual tree as certain never to attain to the next highest class. A tree which is dominated now by another when the latter comes out may possibly shoot up to take its place. We will for the moment leave the attempt at answering this to take it up in its proper order later on.

There is no attempt made to calculate the normal growing-stock and compare it with the real growing-stock, and to carry out fellings in such a way as will result not fortuitously but designedly at the end of the period or rotation in the growing-stock having been perceptibly brought nearer to the normal growing-stock by a series of carefully promoted fellings, which must eventually lead the abnormal increment over to the normal, and enable us to attain to the full utilisation of any surplus stock, or at least of the annual increment provided only both growing-stock and increment are not "below par," when "improvement thinnings" rather than selection fellings would best meet the case.

The very natural result of this policy of "laissez-faire" has sometimes been that not little has been left standing except the lower classes of trees in many of the sal forests.

True, these cases apparently have been the result more of injudicious "improvement fellings" rather than of "selection fellings," and with area and no girth-check, but while there the mistake was over-cutting, elsewhere it has been under-cutting, a lesser evil perhaps, but none the less an evil for all that. Small wonder either that such should have been the case, when unscrupulous people tried to obtain "sustained yields" from "improvement fellings" in partly ruined forests.

But our quarrel is with selection, not improvement fellings, and our concern with normal growing-stocks and proportionate fellings.

Having explained the general principles on which we would base our working-plan prescriptions, we will now proceed to enunciate our theory and to demonstrate what appears to us to be an arguable and possible method of carrying out proportionate fellings, by trying to show that, if there are no actual data *available as to what the proportions of the girth classes in a* "truly normal" forest should be, there is at least material to hand of a sort, only waiting to be applied.

MORE LIGHT.

(*To be continued.*)

Notes on Sandal.

(*Concluded from page* 362.)

VII.—ARTIFICIAL REPRODUCTION.

45. THE question whether the existing natural sandal areas can be relied upon to produce all the sandalwood that is consumed annually, or whether it should be supplemented by artificial plantations to meet the demand, has been dealt with at much length by more experienced hands, but so far as I can gather a definite and precise answer has yet to be given. I do not propose to enter into that difficult question here, but shall merely remark in passing that provided natural reproduction is encouraged and fostered in a proper manner, there will be little necessity to resort to costly artificial plantations.

46. So far as our experience of the existing sandal plantations in Mysore, Coorg and the Madras Presidency goes, I believe the general consensus of opinion is that they have proved a failure, or at any rate that they are not a success, notwithstanding that a few plantations in the neighbourhood of Bangalore are said to be otherwise. The plantations in Coorg and Mysore seem to have been very promising up to the age of 10 or 12 years, but to have shown signs of failure after that age. In most cases I believe the sites selected were bare open lands. This was a serious mistake, committed through ignorance of the life-history of the sandal. When young the sandal was probably content to live on the nourishment furnished by the roots of grasses and other herbaceous growth that covered up the open lands. As it grew older the scanty nourishment its pigmy host could furnish was quite insufficient for its growth and development. The supply of plant food was further diminished by the weeding out of all herbaceous and shrubby growth that came up in some of the plantations, and this proved a greater mistake than the initial one of selecting bare localities, and to it I attribute the failure of plantations after the age of 10 or 12 years.

47. In this connection two question arise (1) can sandal be grown *successfully* and *profitably* in plantations? and (2) if so, under what condition? As regards the first we may answer it in the affirmative without hesitation. Even away from

its natural surroundings I have seen sandal growing vigorously and producing good scented wood in the hedges of gardens, in the compounds of bungalows, and in the neighbourhood of cultivation. I would mention that I have noticed this in many places, and among others, in the Salem Town at an elevation of 950 feet, Kallavai in Uttankarai Taluk and Jagadevi and Burgar in Krishnagiri Taluk of the Salem District, the last three being at an altitude of about 1,300 feet only. There is therefore no reason to doubt its possible successful growth in plantations formed within its own habitat, provided of course all the favourable conditions are present. What those conditions are, the reader will doubtless gather for himself from my previous remarks regarding "natural reproduction."

48. Although I have had no practical experience of forming sandal plantations, yet I have ventured to submit for the consideration of Indian Foresters some ideas which have suggested themselves to me on the subject. They may be arranged under the following three main heads: (1) choice of locality; (2) method of stocking; and (3) after-treatment.

(1) Choice of Locality.

49. Unless a plantation of sandal is undertaken on a small scale purely for experimental purposes, the choice of locality for its formation and growth on commercial principles must, of course, be limited for obvious reasons to the natural *habitat* of the species. In selecting the site for a plantation, the following factors should be considered :—

(*a*) Condition of the site wooded or bare; (*b*) drainage; (*c*) aspect; (*d*) altitude; (*e*) soil.

As regards (*a*), a site wooded with indigenous species of trees and shrubs, especially those in whose society the sandal is, by experience and observation, found to produce the best quality and the largest quantity of scented wood should be preferred to bare land. Although we have as yet no positive proof that the associates of sandal influence the development of scented wood in it and that some of them do so in a much greater degree than others, yet I believe strongly that such is the case. What appears in paragraph 2 of Mr. A. W. Lushington's article on page 113 of the "Indian Forester" of March 1903 and in paragraph 14 *supra* of this article, may be taken as sufficient, though admittedly too slight and inconclusive to be classed as scientific evidence to justify my belief, which is further based on my general observations of sandal trees in different parts of the Salem District. The scientific determination of the important and interesting point in the life-history of sandal is more the work of specialists with the requisite knowledge and means of conducting investigation than of practical foresters. The latter can, however, collect useful information in the field by observations as to what species of plants influence the development of scented wood in

sandal in greater or lesser degree than others, and it would be well worth the trouble of all Forest Officers to do this who have sandal forests in their charge.

Now to return to the subject of the condition of site, my reasons for selecting wooded in preference to bare land will be found in the remarks on "Natural Reproduction." When such land is selected, the growth on it must be felled, leaving here and there a few trees and shrubs, and the land then ploughed up. Where ploughing is not practicable the soil must be worked up by digging with the hand. If a wooded site is not available and bare land has to be taken up, it should first be clothed up with vegetation before planting or sowing is undertaken; this can be done quickly by first ploughing the land and sowing seeds of *indigenous species of trees and shrubs.* When these auxiliary species have come up well, then the land may be sown or planted with sandal. The ploughing of the land is required only where the soil is hard and dry, but where it is naturally friable and loose this operation may be dispensed with.

(b) *Drainage.*—Sandal does not occur in nature in water-logged localities, or at any rate it does not thrive on them. It wants *well drained soils, and therefore any site selected for* plantation must have good natural drainage. A gently sloping land is preferable to a flat level one.

(c) *Aspect.*—As far as my observation goes, the influence of aspect on sandal is much greater than Mr. P. M. Lushington is inclined to believe, *vide* the last para. on page 9 of his "Notes on the Sandal Tree in Southern India." The eastern and southern *aspects are distinctly more unfavourable than other aspects unless* they are sheltered by higher ranges or ridges of hills. Western and northern aspects appear to be more favourable, and where possible I should select a locality with one of these two aspects or any variation of either. It is true that sandal occurs naturally on all aspects, but on eastern and southern ones it is less promising, especially at lower elevations. I have seen very good natural growth of young sandal in the inner Javadi Reserve of the Salem District on a steep eastern slope at an altitude of 3,600 feet, but here the hill-side is very well wooded and the leaf-canopy is almost complete, so much so that the direct rays of the sun rarely reach the ground, while there is plenty of infiltrated light. This is exceptional rather than general, as I have hardly seen a like instance elsewhere on the Javadis.

(d) *Altitude.*—Since the choice of locality is limited to the natural habitat of sandal, it is perhaps superfluous to deal with altitude here. Nevertheless, a few remarks seem to be called for as the range of elevation within which sandal is found to grow in the Salem District varies from 950' (Salem town) to 4,600' (Shevaroy hills) above sea level. These are doubtless extreme altitudinal limits within which sandal plantations may prove successful; but the normal limits within which the bulk of

natural sandal occurs varies from 2,000′ to 3.700′ on the Javadis, Yelagiris, Melagiris, and Javalagiris; I should certainly select a site between these limits approaching as much as possible to 3,000′ and above rather than below it.

(*e*) *Soil.* – Sandal is rarely ever found in purely sandy, clayey or marly soils. It occurs in rich deep friable loams and also in very stony dry soils; its growth in the former is rapid and luxuriant, and trees attain considerable dimensions, whereas on the latter soils it is slow, stunted and the tree rarely attains more than 2½′ girth. I have found the best growth of sandal on deep ferruginous red loams with a moderate admixture of stones. On such soils, trees of 3′ to 5′ girth are common. For a plantation, it is desirable to select such red loams. Trees grown on poor stony and dry soils are believed to yield more highly scented wood than those grown on rich deep soils. There appears to be some reason for this belief, but it is for further observation and study, as also the question whether by a judicious and careful selection of the associates for the sandal, the richness and development of the scented wood cannot be improved on deep rich soils. As observed by Mr. P. M. Lushington, trees grown on rich soils produce age for age above a certain limit a much larger quantity of scented wood than those on poor dry soils, and this is an important point to be remembered in selecting the soil for a plantation.

I have omitted to deal with the climatic conditions favourable to sandal, because the locality to be selected for a plantation being within the *habitat* of the species, its climatic requirements presumably exist there. Moreover, these conditions are fully dealt with in Mr. D. E. Hutchins' note on "Sandal" published in Vol. X of the "Indian Forester," and I have nothing more at present to add to his remarks.

(2) *Method of stocking.*

50. Under this head we may breifly consider (I) preparation of the ground; (II) composition of the crop; and (III) mode of stocking. In respect of (I) I have already said that where the soil is hard, it requires to be loosened by ploughing or digging. If it is loose and friable, it seems sufficient to merely scratch it up in small patches of, say, 6″ square and 2″ or 3″ deep under or amidst clumps of coppice bushes or scrub. In my opinion it is unnecessary to dig costly pits of one yard cube, as was originally done in Mysore, nor need we dig pits of larger dimensions than 6″ square, as above recommended. Apart from the costliness of pitting, there is the risk of preventing or retarding quick formation of root-connections between the sandal and its associates by sowing or planting in the centres of larger pits. Where ball planting is resorted to, which I would do only as a last resource, pitting will become necessary, and even then the pits should be just large enough to hold the balls of earth with which the

seedlings are transplanted. If *dibbling in* of seed is the mode of sowing adopted, no previous pitting or scratching in friable soils appears necessary, all that is required being a hole made with a pointed stick and the seed dropped therein.

(II) *Composition of the crop.*

51. From what has been already stated under "*Root-parasitism*" and elsewhere in the course of these notes, it will be readily understood that the sandal is of all tree-species the most unsuitable to be grown as a pure crop. This was recognised so far back as 1884 by Mr. D. E Hutchins, although he was then doubtful about the root-parasitism of Sandal and recommended a mixture of other species with it on other grounds, *vide* page 25 of his article on "Sandal" already referred to. Nevertheless in the earlier sandal plantations it was planted pure, and with what lamentable results we all know now. With our present knowledge of the life-history of the sandal the mistake could hardly be repeated. As to what species are the most suitable to be mixed with the sandal, we are not yet in a position to make a full and precise statement, investigation being incomplete. But we have already a long list of associates to which I may now add Citrus aurantium, Clausena indica, Dalbergia paniculata, Derris scandens and Cocos nucifera, with all of which it has been since found that sandal forms intimate root connections. Out of this long list I would select the Albizzias, Acacias, Dalbergias, Ingas, and Pongamia and climbing Papilionaceous plants of the Leguminoseæ; the *Zizpyhus* and *Sacutia* of Rhamneæ; Premnas, Vitex and probably Tectona of Verbenaceæ; the Anonas, Uvarias and Polyalthias of Anonaceæ; Litseas and Alseodaphne of Lauraceæ; Citrus, Clausenas, Limorias, Atlantias and other genera of Rutaceæ; Melias and Cipadessa of Meliaceæ; Cudrainas, Streblus, and Holoptebea of Urticaceæ; Wrightias and Carissas of Apocynaceæ; Thespesia of Malvaceæ; Date and Coconut palms of Palmeæ, and Bambuseæ of Gramineæ. I mention these specially because I have found their roots largely attacked by sandal. This list will, doubtless, be considerably modified as our investigations make further progress. It need hardly be mentioned that as far as possible the auxiliary species selected should consist of species indigenous to the locality and capable of enhancing the value of the plantation by the timber or other produce they yield. I should not depend upon only one or two kinds of associates, but would have as many different species as possible.

(III) *Mode of stocking.*

52. Mr. D. E. Hutchins has given in his note already referred to a detailed description of the two principal methods of stocking, namely (1) sowing *in situ* and (2) planting, which were tried in a variety of ways in the Mysore Province. The

results of these operations as reported by the late Mr. Ricketts and Col. Campbell Walker are given in full in Mr. P. M. Lushinton's notes, which also contain the results of similar operations conducted in Coorg and elsewhere. From all that has been written on the subject, one gathers that the artificial reproduction of sandal has not proved a success. Whether this is due to something inherent in the species which prevents its artificial regeneration or whether it is due to faulty systems of sowing and planting adopted, it is difficult to determine with the data available. My own idea is that there is nothing in the innate nature of the sandal itself to prevent its regeneration in a plantation, provided its peculiar root-parasitic habit and its requirements in consequence of that habit are duly considered and provided for.

Of the two modes of stocking I think sowing *in situ* is preferable to planting for these reasons—(1) its cheapness; (2) its being more in accord with the method adopted by nature; (3) its freedom from the risks of damage to the young roots of sandal and their root-connections with other plants; and (4) freedom from watering. I believe the Mysore and Coorg Forest Officers have given up planting altogether and are adopting the method of sowing *in situ*. Which of the several modes of sowing broadcast, or in patches, or by dibbling in, or a combination of any two or all the three should be adopted, is a matter for local conditions and circumstances to decide. Whichever the method adopted, the sowings should be amidst or under the shelter of scrub or bushes, and never in the open. The operation should be done at the first burst of the south-west monsoon, generally May to July, so that the young seedlings may have a good start before the succeeding hot weather begins.

If the site contains natural sandal trees scattered over it, root-suckers may be encouraged to sprout up and supplement the seedling crop by exposing and slightly injuring their roots here and there.

(3) *After-treatment.*

53. I should strongly object to *weeding* of any kind if that term includes pulling up by the roots. It is a most dangerous operation in the case of sandal, which establishes very early root-connection with surrounding vegetation. If there is danger of its being choked up, the surrounding growth should be cut back above the ground, taking care not to disturb the roots and not to expose the seedlings to the sun. More than this is quite unnecessary and probably injurious. As the seedlings grow their crowns require to be free while their stems need shelter, and all our *after-treatment* operations such as *cleanings* and *thinnings* should be limited to afford these facilities. Pruning is hardly necessary, and must be avoided unless it could be done skilfully, as otherwise there is greater danger by doing it than

from no pruning at all. Of course, the plants should be freed from climbers, which should be cut back but not grubbed up.

The young plantation must be rigidly protected from fire and cattle, but if the growth of grass is dense and likely to choke up the seedlings, either the grass must be cut off or light grazing allowed. In a well formed plantation, with the ground adequately sheltered by the auxiliary species, the growth of grass should be at a minimum.

54. These notes do not profess to be either complete or altogether original. I have ventured to submit them to the readers of the "Indian Forester" because I feel that there is much more yet to be learnt of the life-history and sylviculture of this most valuable of all Indian Forest trees than we already know. Should this article excite further discussion of the subject in all its aspects and lead to definite and precise conclusions, I shall feel fully rewarded.

CAMP TIRUPATUR :
16th May 1904.

M. RAMA RAO.

A New Termite in India.

TERMOPSIS RADCLIFFEI—N. SP.

THIS new species of white ant is of considerable interest to Forest Officers in the Himalayas. It had been known to exist for many years by the author, and about two years ago I sent specimens to the Editor of the "Indian Forester" for identification, but owing to the rather damaged condition of the specimens this could not be done. Last year Mr. Wroughton, late of the Indian Forest Service, visited Kashmir, and I pointed out where to find

the termite, and told him all I knew about them. Mr. Wroughton then, apparently, sent the specimens he collected to M. J. Desneux (Bruxelles) for identification, and the following description is from his pen. M. Desneux had unwittingly named the species after Mr. Wroughton, but this will now be altered. This termite can be found, in Kashmir, on almost any fairly old blue Pine (pinus excelsa) stump by removing the bark at the foot near the ground. The ant does not construct earth mounds like those made by termites in India proper. At present very little is known of this highly interesting species, but I hope to make further investigations this year. As it is the only termite in the Himalayas, and the species is quite new to India, the study of its habits should be very interesting, especially so as by their actions the destruction of pine stumps is greatly accelerated, a fact which should be appreciated by Forest Officers who know the length of time it takes for pine stumps to rot away. The following is the description by M. J. Desneux read before the Bombay Natural History Society, on January 21st, 1904 :—

TERMOPSIS RADCLIFFEI — N. SP.

Winged form, upper side yellowish-brown ; head and prothorax darker, reddish-brown.

Head rounded, flat; eyes large, almost reniform. Ocelli totally absent. Antennæ larger than head and prothorax, of 24 segments ; first segment longer than 2nd, third segment shorter than 2nd. Prothorax narrower than the head, lateral sides depressed.

Cerci long, of 6 segments. Abdominal papillæ long.

Tarsi furnished with a plantula.

The wings venation is that of termopsis, notwithstanding some difference.

The costal area is on the whole similar, but while the mediana of T. angusticollis, Hagen, of California (the only one living known species of this genus, of which the winged form is described) is nearly straight from base to apex, the mediana of our species is distinctly curved, and the greatest distance between it and the subcosta lies near the middle of its curve.

The sub-mediana is far longer than it is the case with T. angusticollis, and the number of veins it emits is also greater.

The veins are almost invisible, with the exception of the costal branches, and of the basal branches springing from the submediana, which are distinct.

Length of body: 11 m. m.

Length and width of anterior wing : $19 \times 5{\cdot}5$ m. m.

Soldier: Robust. Head rectangular, reddish-brown, anterior portion darker ; mandibles black.

Eyes present, small, ovoid, black.

Left mandible furnished with very strong tooth.

Mesothorax and metathorax furnished with rudiments of wings similar to those which Hagen describes and figures for the soldier of Termopsis occidentis (V. *Linnæa Entom* XII, p. ff, pl. 1, f. 8). A peculiar character of this soldier is the exceptional size of the cerci, which are much longer than in any other known termite, and which give to the posterior part of this soldier some resemblance with that of an earwig.

Length: 15 m. m.

Hab: Kashmir Valley (E. Radcliffe, July, 1902.)

The discovery of a termopsis in India is of the highest interest. This genus was hitherto only represented by two species inhabiting California and Central America and by two fossil species from the amber of Œnigen (Prussia).

KASHMIR.
15th June 1904.

E. RADCLIFFE,
Forest Department.

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Eyes present, small, ovoid, black.

Left mandible furnished with very strong tooth.

Mesothorax and metathorax furnished with rudiments of wings similar to those which Hagen describes and figures for the soldier of Termopsis occidentis (V. *Linnæa Entom* XII, p. ff, pl. 1, f. 8). A peculiar character of this soldier is the exceptional size of the cerci, which are much longer than in any other known termite, and which give to the posterior part of this soldier some resemblance with that of an earwig.

Length: 15 m. m.

Hab: Kashmir Valley (E. Radcliffe, July, 1902.)

The discovery of a termopsis in India is of the highest interest. This genus was hitherto only represented by two species inhabiting California and Central America and by two fossil species from the amber of Œnigen (Prussia).

KASHMIR.
15th June 1904.

E. RADCLIFFE,
Forest Department.

Reproduction of Teak in Areas of Flowered Bamboo.

NOT being in charge of a Kyathaungwa (Bambusa polymorpha) division I do not know what stage has now been reached in the discussion of or what decision have been arrived at regarding the treatment of Kyathaungwa teak forests when that bamboo flowers. But I have often wondered why there is this interminable writing about and this interminable waiting for the flowering of a particular bamboo, when many others, spread over areas at least as extensive as those occupied by Kyathaungwa, are ignored. Why are no schemes prepared for Tinwa (Cephalostachyum pergracile) which extends over enormous areas in both Upper and Lower Burma, and the gregarious flowering of which I have myself witnessed on more than one occasion; or for Myinwa (Dendrocalamus strictus) which flowers yearly to a greater or less extent in almost every division in which it is found; or for those bamboos which are found gregariously in one or two divisions only? From the day the Forest Officer enters Burma he is taught, unintentionally no doubt, but none the less surely, to look upon the Kyathaungwa as a thing apart instead of merely as one of a kind, with the result that numberless

opportunities for studying by actual experiment the effects of different methods of treatment in areas of flowered bamboo have been lost, frequently without comment. Let us then cease this endless writing about the flowering of Kyathaungwa and accustom overselves to think about the flowering of "the bamboo;" let us evolve some scheme of work for the reproduction of teak in flowered bamboo areas which will become as much or even more a part of the routine work of the Forest Officer as fire protection or the preparation of working plans; and above all let us ask for the extra establishment necessary, and start work at once.

Now, all the proposals that I have seen for the treatment of flowered bamboo areas involve a sudden and very large increase in expenditure, and, if success is to be assumed and other forest operations are not to be neglected, a sudden and very large increase in establishment. The money would no doubt be forthcoming, but the establishment, even if it were forthcoming, which I very much doubt, would be untrained, inexperienced, and useless. In just the same way then as special officers are appointed for the preparation of working plans I should like to see special officers appointed for work in areas of flowered bamboo. They need not be officers of rank above a ranger, should be subordinate to the divisional officer within whose jurisdiction their work lies, and would of course be transferred from place to place as circumstances demanded. I would recommend that the increase in the staff necessary be spread over a period of say ten years; firstly, because a sufficient number of duly qualified men could not be obtained at once, and, secondly, because it is not advisable to undertake operations on a very large scale until they have passed the experimental stage.

I do not propose to enter into any discussion as to the method of treatment to be adopted. The best method can, I feel sure, only be determined by experiments systematically carried out over a series of years; but whatever the method evolved, it will almost certainly be found applicable, except in matters of detail, to all species of gregariously flowering bamboo. Some experiments have already been made, but the results are not generally known, and, judging by the differences of opinion still manifest amongst Forest Officers, are by no means conclusive.

There need be no fear that the extra establishment which I advocate would have nothing to do in the unlikely event of there being in any year no flowering of bamboos in any part of the country, for operations in any one area would probably extend from the year of flowering to a year or two years after the falling or destruction of the dead culms. I would moreover invariably carry out creeper-cutting and improvement fellings (now so much neglected, and to my mind of far greater importance than fire protection) simultaneously with the cultural operations amongst the flowered bamboos.

A re-arrangement of divisional charges and a re-organisation of both the controlling and executive forest establishment in Burma is now under consideration, and the opportunity thus afforded of obtaining the necessary increase in establishment should not be lost. Little or nothing can be done at present. We have not even men enough to carry out the prescriptions of sanctioned working plans.

"THITTAW-WUNMIN."

The Ripening of the Cones of Pinus Longifolia.

BABU Birbal, in stating that the female flowers at the base of the flowering shoot only are fertilised, gets very near the solution of his difficulty, but does not appear to be aware of it. I would refer him to page 500 of Mathien's *Flore Forestiere*, 1877, on the subject of pines in general. He will there find it stated that the flowering of pines is not followed by the immediate fertilisation of the ovules. The pollen-tubes do not attain their full development and consummate the fertilisation of the ovules until the month of June of the following year. Until then the cones remain quite small, without developing; but as soon as the ovules are fertilised the cones grow rapidly, and reach their full size either the same or the following year.

RANGOON:
10th July 1904.

F. B. MANSON.

Instructions for sending Parasitic Fungi to the Cryptogamic Botanist to the Government of India.

CAREFULLY chosen specimens, selected so as to illustrate all stages of growth of the fungus, should be sent in all cases

For selection, it is advisable to collect a large supply of the material and to go over it afterwards at leisure, picking out several of the best examples of each stage for despatch. The first apprearence, the full attack, and the final condition should be shown.

Specimens should never be packed damp, as this leads to the growth of moulds, which interfere with the examination of the parasite.

In the case of leaf parasites, the leaves should be pressed between blotting-paper while still fresh, so as to prevent the curling up of the leaves on drying. A large number of specimens can, when dried in this manner, be packed into a small space between flat pieces of card-board and sent by post.

Large fungi, such as those found growing on trees, should be very thoroughly dried between blotting-paper for three or four days, changing the paper each day, or in the sun ; then wrapped separately in tissue paper and packed in a box or tin.

Soft or brittle fungi may be sent in methylated spirit or whisky, in a bottle, very securely sealed.

When the plant attacked by a parasitic fungus is not certainly known, specimens of its leaves and flowers pressed between blotting-paper should be sent for identification.

Where the localisation of the disease is not apparent (as when the plant is dying from a "wilt" disease , whole plants, including the roots, should be sent. Small plants may be pressed whole and sent by post. Larger ones, such as sugercane, can be sun-dried, wrapped in gunny sacking, and sent by train. Brittle plants, such as cotton, are best packed in a box and sent by train Very large plants, such as trees, cannot, of course, be sent whole, and an attempt must be made on the spot to select specimens of the various parts of the plant likely to be diseased.

Roots should always be sent where a flow of gum from the trunk is a symptom of the disease.

It is sometimes necessary to send two or three samples at *intervals of a few weeks to illustrate the stages of the disease.* Usually, however, a careful search, when the disease is at its height, will yield specimens showing the different degrees of attack.

Some of the leaves and twigs killed by the disease should be collected and sent in the case of leaf and twig diseases, as a *special, enduring condition of the fungus often occurs only* on the dead parts.

The information particularised in the accompanying list should always be given where possible.

Information required.

(1) *Locality* (with *name* of *village* and *district*).
(2) Vernacular name of disease.
(3) Name of crop or plant affected.
(4) Area affected.
(5) Extent of injury.
(6) Date of first appearance.
(7) Time of year when disease is prevalent.
(8) Previous occurrence
(9) Conditions of climate, temperature, etc., which are said to favour or check the disease.
(10) Remedies used.
(11) *Are manuring and rotation practised ?*

A Manual of Forest Engineering.

By C. G. Rogers.

Mr. Rogers' book has been a considerable time in issuing, but we have now got the third and last volume, and can consider the work as a whole We think the Manual of the greatest possible value to Indian Foresters (both Officers and Rangers), as well as to the many persons (such as planters) who in India have to do their own engineering. Considering the purpose of the book the extreme minuteness of detail is generally justified. For example figure 87 of Volume III shows a hook support on a wire ropeway with every part dimensioned. As Forest Officers who have to erect wire ropeways are generally in divisions at great distances from civilisation, they have usually to construct everything locally, and will therefore be very grateful for full details. Still sometimes we think the descriptions might have been written more concisely. . The book is conveniently divided up into three main heads—Buildings (Volume I); Roads (Volume II); and Miscellaneous (Volume III). Quite properly the roads and buildings treated of are not complex; they are just what Forest Officers have to deal with. Volume III is for the most part applicable to the forest alone, and contains information not to be found in ordinary *engineering works. It deals at full length with mechanical* methods for transporting and handling timber and fuel, and very conveniently brings together a quantity of information on such matters as wire ropeways, sledge roads, water slides, tramways, and timber catching booms for which one usually has to look in a variety of pamphets and prospectuses. Although no doubt Volumes I and II contain many hints specially useful to Foresters, these latter might make shift to get on with ordinary engineering books as used by Engineers when dealing with buildings and roads, but without Volume III they could not easily obtain the information they need for works of a nature which may be called

forest engineering proper. Mr. Rogers has, as far as possible, described forest transport works actually in action. One form of transport is omitted, however, which we should think would be specially adaptable to forest work in flat country, as for example in Oudh.

We mean the Monorail. We know of one monorail actually in use in the forests, namely, at Alapilli in the Central Provinces. In this same volnme is a head for wells. We do not think it has been sufficiently clearly intimated that a well is not merely a hole sunk to the underground water level, and that the object of the well-cylinder is not merely to prevent the sides falling in, but also, and principally, to ensure that the water obtained has been filtered through as many feet of earth as the tube is long. The author has in this volume especially, but also in Volumes I and II, collected all the information possible from brother Foresters; a very sensible plan in our opinion. The book is especially noticeable for the extreme industry with which it has been compiled. The very numerous figures will be most useful. As a rule they are admirably clear, and, as they should be, diagrammatic, but just occasionally the attempt to reproduce photographs has been unsuccessful (*e.g.*, Figure 86 of Volume III). Figure 115 of Volume II is upside down. The print is all that could be desired so far as clearness in concerned, and there are broad margins to the pages, which will be useful for notes. Forest Officers will often want to enter notes which their experience may show to be useful. A special feature is the description given below each figure. The Indices at the end of each volume will be decidedly useful. All Forest Officers should have this book in their library, and the occasions will be rare when Forest Officers need to go further afield for their engineering information. Still the methods treated of in Volume III are constantly improving, and new ones being discovered, and it may therefore be advisable later on to issue a new edition of this volume. For example, the simple plan called telescopic sliding has in small torrents done marvels towards bringing within reach of the market forests previously thought too distant to be exploitable. When a new edition issues we would add the monorail above referred to, if the experience of Forest Officers shows it to be a useful means of forest transport.

The Long Round to England.

The following corrections should be made in the July number of the "Indian Forester":—Page 330, line 37, after "*lumbering* camps" add "daily;" page 330, line 44, after "the greater" add "value." Page 331, the titles of the two illustrations facing this page should be transposed.

VI.—EXTRACTS, NOTES AND QUERIES.

Education in Forestry.

BY W. R. FISHER.

ALL considerable European countries, except perhaps Portugal, have forest schools. In France there is the National Forest School, founded at Nancy in 1826, where, besides the candidates for employment in the State forests, about 350 other students of all nationalities, but chiefly Roumanian, English, and Belgian, have been taught since 1830. There is in France also a school for forest guards and foresters at Barres, in the Departement de Loiret, and the best students from this school can rise to the position of forest officers, and may attain the grade of *Inspecteur des Eaux et Forets*, corresponding to our Deputy Surveyors of the Crown Forests, though they cannot, on account of their superior age to that of the Nancy students, become Conservateurs, a rank which is not usually attained even by the Nancy men until they have been in the service for about thirty-five years. There are numerous schools of forestry in Germany, the principal ones being Eberswalde, Munich, Tharandt, Tubingen, Giessen, etc. There are several forest schools in Austria, also in Norway and Sweden, one each for Russia, Italy, Switzerland, Holland (chiefly for the Dutch Colonies), Spain, and Belgium. The Japanese have a forest school at Tokio, there are several in the United States, one in India, and one in Burma.

When we consider the extent of the British Empire, and the large area of forests in the British Colonies, it is evident that the establishment of forest schools is necessary in Canada, Australia, New Zealand, South Africa, and Ceylon. Much more has been done for forestry in India and in our Crown Colonies than in the larger self-governing Colonies, except in the Cape of Good Hope, where there has been a scientific Forest Department for the last thirty years. There are Forestry Departments, under trained officers, in Ceylon, the Transvaal, Uganda, Mauritius, the Soudan, and the Straits Settlements, and the West Indian forests have been inspected officially by an Indian Forest Officer with the view of establishing a forestry department. What is now wanted for the Empire is the establishment of a Forest School in Britain which will train the higher forest officers for India and the Colonies, and instructors in forestry for the larger Colonies, where superior and inferior schools of forestry, on the model of Nancy and Barres, must soon be established. For service at home, the future higher officials of the Crown forests will require thorough instruction in forestry and also the instructors in forestry at the Agricultural Colleges, at Edinburgh, and at the school for woodmen established at the Forest of Dean, another of which class is proposed for

Alice Holt Wood. Such a school will also afford instruction in forestry to the sons of our landowners and to men preparing at our Universities for the posts of land agents to large estates.

I propose here to give a short account (chiefly taken from Ribbentrop's "Forestry in British India") of the instruction adopted for our Indian forest officials, who have hitherto formed the principal corps of trained foresters in the British Empire, and to discuss the advisability of now extending this instruction so as to include all the classes mentioned above, whose services are required to make forestry a serious pursuit throughout the Empire.

The necessity for establishing a Forestry Department in India was first realised in 1806, when Captain Watson was appointed Conservator of Forests in Malabar, chiefly to protect the growth of teak and other timbers for the Navy, but a reaction ensued in 1823, owing to complaints of the traders, and the conservatorship was abolished. Great ravages were then allowed in the State forest, and it was not till 1842 that Mr. Conolly commenced the plantation of the famous Nilambur teak plantation, and in 1847 Dr. Gibson, a botanist of note, was appointed Conservator of Forests in Bombay, and in 1856 Dr. Clegborn, Conservator of Forests in Madras. In 1852 Pegu, with its splendid teak forests, was annexed, and Dr. McClelland appointed Superintendent of these forests; but a permanent policy for the forest administration of India was first laid down by Lord Dalhousie in 1855, Dr. Dietrich Brandis, the brother-in-law of General Havelock, being appointed Superintendent of the Pegu forests in 1856, and the forests of Tennasserim and Martaban being added to his charge in 1857.

Dr. Brandis then introduced those principles of enumeration and organisation to the working of the forests, that form the basis of our present working plans, and created a practical system of working the Burmese forests of teak, with due consideration to the perpetuation of the trees by natural and artificial regeneration.

His conservative policy interfered with the gains of timber merchants, who were very powerful in Rangoon, and they prevailed so far on the Government of India that orders were issued to open all the Pegu forests to private enterprise, but the selection of the trees to be felled was left to the control of the Forest Department. Fortunately the Tharawaddy forests were still worked under complete departmental control, and after a few years' experience the State lost about £1,000,000 in the open forests, whilst the Tharawaddy forests produced a large regular income. Canadian timber merchants still form the greatest obstacle to scientific forestry in the Dominion of Canada.

Dr. Brandis had gained the day against the timber traders, and in 1862 was appointed Inspector-General of Forests for the Government of India.

Up to this time officers were appointed to the Indian Forest Service without any special training, but Dr. Brandis came home in 1866, and induced Lord Salisbury, who was then Secretary of State for India, to appoint trained men for the service. Dr. Schlich and Mr. Ribbentrop, who were trained in Germany, were then sent out to India, and these officers, both of whom eventually became Inspector-General of Forests, greatly assisted Dr. Brandis in his work of establishing a scientific Department of Forestry *in India. At the same time, eight candidates were appointed by* the Secretary of State for India to undergo training in France and Germany, and these men went to India in 1869. Another batch of trained forest officers went out in 1871, and the Continental training was continued in Germany till 1875, and in France till 1886. Dr. Brandis was deputed to Madras, in 1881, to reorganise the Forest Service in that Presidency, and retired from the service in 1882, becoming Sir Dietrich Brandis, K.C.I.E., and was also appointed a Fellow of the Royal Society, and now, in his eightieth year, he is still working at Kew at a comprehensive manual of the Indian forest flora.

Dr. Schlich, who succeeded Sir D. Brandis as Inspector-General of Forests, was deputed home in 1885, to inaugurate a course of instruction in forestry, at the Royal Indian Engineering College, Cooper's Hill, a place admirably suited, owing to its *proximity to the Windsor Forest (14,000 acres), to the beech* woodlands in the Chiltern Hills, and to the coppices-with-standards in Surrey and Sussex, and to Kew Gardens, for instruction in forestry and botany.

The course of instruction at Cooper's Hill comprises drawing, surveying, road-making and building, accounts and German, elementary chemistry, and the chemistry of soils and physics, entomology, botany, geology (including that of India), and forestry. Thoroughly practical instruction in forest nursery work, and in planting operations, have been given, and the students have also been taught methods of natural regeneration of forests and thinnings in the Chiltern Hills, and in the fine French forests. Besides this they have spent nine months every year in the Prussian forests, where they are placed only two together, under specially selected forest officers, so as to learn the practical management of large areas of forest.

Cooper's Hill College is now to be closed, as the Secretary of State hopes to recruit the Indian engineers from the various engineering colleges in Britain, coupled with experience gained in one year's practical work with some engineering firm. Fresh arrangements have, therefore, to be made for the instruction of our Indian forest students, and this it is probably intended to secure at one of our Universities. It is no longer necessary *to have recourse to the Continental forest* schools, for the following reasons:—

Since 1886, when training our men at Nancy was abolished, considerable progress has been made in forestry in Britain. Dr. Schlich, who besides possessing a thorough knowledge of theoretical forestry, has managed a woodland of 3,000 acres in the Ardennes for the last ten years, and also more recently the 8,000 acres of the Duke of Bedford's woods, is a good practical forester. No one can be better qualified for starting a superior forest school for British and Colonial forestry, the necessity for which I have already explained. Continental forest schools do not, as a rule, take a wide view of forestry. Each State in Germany has its own system of management, which is not always applicable to other countries; thus neither the clear-cutting system, practised in Saxony and elsewhere, nor the compartment shelterwood system, are generally applicable to India, where the selection system and the system of coppice-with-standards prevail, and where it is hoped to introduce the group system, which at present is carried on only in the Grand Duchy of Baden, in Europe. It is also necessary that our Indian forest students should have some notions of tropical and sub-tropical forestry, and should know something of Indian history, Indian law and land management, which they will not acquire at a Continental forest school. A succession of experienced Indian forest officers, who have been trained by Dr. Schlich and myself, will be available eventually to succeed us as instructors in forestry, while their services would not be available at a Continental school.

Forest management has also made much progress in Britain during the last twenty-five years. The woodlands of the Duke of Bedford are now managed according to a continuous working plan, so are the High Meadows Woods attached to the Forest of Dean, the working plan for these having been prepared by my lamented friend, Mr. H. C. Hill, who was for sometime Inspector-General of Forests in India. Lord Selborne's woods, near Woolmer Forest, are managed according to a working plan prepared by Dr. Nisbet. Mr. Munro Fergusson's woods in Fifeshire, the Alice Holt Woods attached to the New Forest, are also under working plans. The magnificent forests of France and Germany have been placed at our disposal by the friendly Governments of France and Germany for our students to learn the management of forests on a large scale.

Sir W. Thyselton Dyer, in giving evidence before the late Committee appointed by the Secretary of State for India, to arrange for the future teaching of the Cooper's Hill students, said that one of the most difficult duties that fell to him, as official adviser to the Colonial Office, was the selection of forest officers for the Colonies, and that under present circumstances he could not find properly trained British candidates for such posts. Surely we no longer wish our Colonial forestry appointments to be held by foreigners, and the only way to avoid this in future, as well as to afford the best training for our Indian forest officials,

and to keep up a high standard of *forest training for* our landowners, land agents, and for future instructors of forestry throughout the Empire, is to take the present *opportunity of* establishing an Imperial Forest School at one of our Universities. —*Land Agents Record.*

Government Forestry Exhibit

AT THE ST. LOUIS FAIR.

THE Bureau of Forestry of the U. S. Department of Agriculture has prepared for the Louisiana Purchase Exposition the most extensive display it has ever made. The purpose is both to illustrate the work which the Bureau is doing and to show actual forest conditions in all parts of the country. The visitor will see there the most impressive evidence of what practical forestry is, and also its great present and future importance as a means of promoting the national welfare. Lumbering ranks fourth among the industries of the country, and it is a matter of hopeful promise for the permanence of the industry and for the cause of forestry that lumbermen are adopting conservative forest management in their lumbering operations. That agriculture, incomparably the most important of our national sources of wealth, also depends in no small degree on forestry, is not, however, so well understood. Under intensive methods of farming, and with the enlargement of the cultivable area made possible by irrigation, this dependence will become increasingly close. Mining and grazing, too, materially depend on forestry, for mines demand cheap and abundant timber, and the forage which feeds most of the Western stock is one of the important indirect products which, under proper restrictions, the forests may be made to yield. All of these relationships are strikingly displayed in the Forestry Exhibit at St. Louis.

The space allotted to the Bureau of Forestry is in two different, though not widely separated, parts of the Fair grounds. An indoor exhibit is located in the Forestry, Fish, and Game Building, in which is centered also an exhibittion of the lumber industry of the United States. A striking and complete collection of photographic transparencies illustrates forest conditions and problems as they are encountered by the Bureau. Typical single trees and forests, the cutting or harvesting of forests and their renewal by natural reproduction, forest planting in treeless regions or where forests have been destroyed, and damage by fire, insects, over-grazing, etc., are shown most clearly. Nearly all of the transparencies are of large size, some of them 4 by 5 feet. They are arranged to be seen from the inside of an arcade illuminated by natural light, with Eastern and Western forest scenes shown on opposite walls. This series is supplemented by a collection of large colored bromide photographs framed in the

panels of the balustrade which surrounds the exhibit space. On the floor between the balustrade and the arcade are cases which display some specially important phases of the Bureau's investigations, together with a collection of all the instruments used in forest work, the publications of the Bureau, etc. Of particular interest is a large case containing long-leaf pine trunks which show the advantages of the new system of turpentining promoted by the Bureau, and the disadvantages and injurious effects of the old system of boxing. Two other cases exhibit insects and examples of their destructive work. The method of determining the strength of commercial timbers is shown by a testing machine, while the results of tests are shown by charts and tested timbers. There is also a large collection of timbers, both from the United States and Europe, treated by different preservative processes to show the manner of increasing the life of various construction timbers. Several specimens are shown of building and other timbers which have been in use for thirty years or more.

One of the special features of the exhibit is a relief map of the United States cast upon a section of a sphere 16 feet in diameter. By using this type of map the geographical distortion inevitable in flat maps is avoided, and the real relationship of the various parts of the country and their actual position on the globe are correctly shown. The distribution and character of the forests of the country are shown in different colours, as are the location and extent of national and State forest reserves. The forests managed according to working plans prepared by the Bureau and lands upon which plantations have been instituted under Bureau planting plans are also indicated by special symbols. The situation of forest schools and other institutions which afford training in forestry is shown on the map. On another relief map are shown the location of the proposed Appalachian Forest Reserve, the extent and character of forest and other lands included, and the relation of the reserve to the surrounding country.

The outdoor exhibit of the Bureau is on a tract of 2½ acres situated about 300 yards south-west of the Forestry, Fish, and Game Building. Here are displayed, on and about a model farm, forest plantations suited to every part of the United States, practical forest nurseries, and the best forms of wind-breaks which are so important for protection of the western farmers' crops and buildings. The co-operative work of the Bureau in this direction has been very successful, and this exhibit is certain to attract much interest among visitors from the regions in which forest planting has proved its usefulness, both for protection and as a means of providing local supplies of fuel and timber. During the past five years plans for such planting have been put in operation under the direction of the Bureau of Forestry on 210 western farms. The model farm represented comprises a quarter

of a section of prairie land laid out on a scale one-tenth the actual linear measurements, to show a model plan for planting trees in a treeless country. Forty-seven forest blocks surrounding this area illustrate pure forest plantations and various methods of mixing tree species. In each of these blocks the trees are given the actual intervals recommended for planting in the different regions to which the illustrations apply. Methods of growing nursery stock from cuttings, transplants, and from seeds are fully illustrated, as are the various styles of screens used for shading coniferous tree seedlings. The cultivation of four varieties of basket willow is also an interesting feature of the outdoor exhibit. Fields, farmsteads, etc., are laid off with growing trees planted along the fence lines and about the home lot.

In addition to the displays described, the Bureau of Forestry will co-operate with the Department of Mines and Metallurgy in a series of comparative tests relating to the best methods of preserving timbers. For this purpose a complete experimental treating plant, consisting of a small cylinder, vacuum, and pressure pumps and tanks for holding the preservative solutions will be in operation on the outdoor tract of the Department of Mines and Metallurgy. Other plants will show the application of the Giussani and Rüping processes. It is expected that one or more runs will daily be made, when ties and timbers from all parts of the United States will be treated. Close to these experimental plants will be found a cylinder whose operation illustrates the best methods of increasing the longevity of fence posts. In a separate building near the treating plants several testing machines will be operated by the Bureau of Forestry for the purpose of determining the strength of different timbers treated by various preservative processes.

The greatest effort has been made in the preparation of the Government Forest Exhibit to give as complete an exposition as possible of the purposes and work of the Bureau. The result, it is hoped, will be peculiarly interesting and instructive to that vast body of citizens whose material welfare is so intimately connected with the adoption of practical forestry.—*Forestry and Irrigation.*

School of Forestry for Wales.

As *announced* in our last issue, a meeting of delegates representing Welsh County Councils was held at Swansea Guildhall on Friday last week to consider the establishment of *a school of forestry* for Wales. Sir Charles Philipps presided, and he was supported by Messrs. E. Robinson (*Edward Robinson* & Co , Ltd., Boncath), and C. A. Egerton Allen (representing *Pembrokeshire*), John C. Harford (representing Cardiganshire), J. Schofield and J. D. Morse (Carmarthenshire), S. H. Cowper

Cotes and M. Powell Jones (Breconshire), and Mr. Davies George (Clerk to the Pembrokeshire County Council).

Mr. Davies George said in addition to the counties represented, Merionethshire, Glamorganshire, Monmouthshire and Denbighshire had selected delegates, while Lord Aberdare and Sir Marteine Lloyd had written regretting inability to attend.

The Chairman explained the object of the meeting and the steps which had led to the present conference.

Mr. E Robinson expressed the opinion that the principality was ripe for this school, as he found wherever he went an almost unanimous feeling in favour of the scheme. Wales, too, was so admirably adapted for tree growing, and in addition to this there was an almost unlimited demand for pit wood for our collieries. The principal part of our supplies now came from France. He observed in the report of a meeting recently held at Carmarthen that Mr. Drummond said there were 1,700,000 acres of waste and unproductive woodland in Wales. Consider what was lost through this, and it should at once convince the delegates how essential it was that this land should be cultivated and attented to by Foresters, who would advise landed proprietors to grow timber on scientific principles. Pit wood, in his opinion, should be mostly grown in the principality, as it would give the growers a quick return on the capital invested. If suitable timber were planted, Douglas fir or Corsican pine, it being a quick growing timber, owners could commence selling the poles at about 18 years' growth, and the final crop could be cut down within 30 years. At least during the period mentioned 120 to 150 tons of pit wood could be cut. This would give a return of 30*s.* per acre on land, comparatively speaking, not worth more than 2*s.* 6*d.* to 5*s.* per acre. He believed colliery proprietors would prefer the native article, as the timber grew straight and uniform, very lengthy and of a size admirably adapted for pit wood purposes. If a general system of planting were carried out he felt sure a much lower rate would be charged by railway companies for freight, as they could then run special trains, which would in that case reduce the cost of transit quite 30 per cent. This concession should of itself be a great consideration for a general system of tree planting in the principality. It might be thought it was somewhat premature to discuss the question of site, but assuming the delegates agreed with his ideas, one would then have to be purchased between Carmarthen and Newport. This, of course, was a matter of detail when the question was more matured. That the school would be self-supporting after eight or ten years he had not the shadow of a doubt. If the Government refused to advance any money at a moderate rate of interest, County Councils and landowners had power to borrow from the Landowners' Improvement Company at a rate, including principal and interest, if borrowed for 40 years, at the rate of £4 16s. 7*d.* per annum. He moved—"That

the delegates present recommend respective County Councils to vote £500 for the purpose of purchasing land to pay the cost of erecting the necessary buildings for the proposed school of forestry."

Mr. Egerton Allen seconded.

Mr. Cowper Coles said in Breconshire, while the landlords were more or less in sympathy with the question, he was afraid there was not the slightest chance of the County Council supporting anything in the way of advancing money, because they felt the Forest of Dean School was in touch, and also because at Aberystwyth there was a branch of agriculture which might be extended to forestry, and because there was a grant to be made to Bangor. His idea was that the Government should be asked to extend its work in the Forest of Dean.

Mr. Harford said the first thing his Council would ask was what was going to be done with the £500, and what was the scheme? They could not vote money blindly. He had hoped that the meeting would have been a larger one, and that a decision would be come to to apply to the Board of Agriculture to do something for South Wales. He should like to see a great deal done in the way of educating foresters, but what they wanted to know better was how to treat the diseases of trees, especially those now affecting beeches. As to the proposal now submitted, he did not see how they could do any good by supporting it unless a really definite scheme was put before them. As to Cardigan, the county was very much in favour of supporting the farm school at Aberystwyth. He hoped the conference would recommend that the Board of Agriculture be asked either to extend the Crown schools or establish a fresh school for South Wales.

Mr. Robinson explained that what he wanted was for the County Councils to agree, and then they would be able to go to the Government with some chance of success for financial assistance. It did not follow that the Councils need vote any money, but unless they adopted the course he proposed he did not see how they could possibly approach the Government. He wanted to see a school established and run on commercial lines, for he felt confident that in a few years it could be made self-supporting. As to the school at Aberystwyth, if the scheme were to be successful it must be easier of access.

Mr. Cowper Coles said there was a strong feeling amongst growers that they had been planting too much fir, and had not sufficiently encouraged the cultivation of ash and other hardwoods, which no imported timber could touch.

Mr. Scourfield, while supporting the suggestion, agreed with the unlikelihood of County Councils contributing, and eventually Mr. Robinson reluctantly withdrew his motion, and on the proposition of Mr. Cowper Coles, seconded by Mr. Harford, it was unanimously agreed "That the delegates present strongly

recommend to their respective County Councils the establishment of a school of forestry, and that they consider the best means of carrying the resolution into effect by asking the assistance and advice of the Board of Agriculture in giving a grant to existing colleges or such other schools or colleges as may from time to time become necessary."

It was resolved that a further meeting be held at Swansea, probably in August —*Timber Trades Journal.*

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Proportionate Fellings in Sal Forests.

(*Continued from page* 397.)

II. For clearness sake we will take a numerical example. We have a sal forest of 80,000 acres, for which a working plan is required. The method is to be "selection."

We may say *en passant* that we have an actually existing sal forest in our mind's eye, and the following suggestions are based on what would appear to us to be suitable prescriptions for such a forest, and are not purely visionary and imaginary.

Well, this forest in the first place consists of *one species*, growing under a variety of conditions.

There are certainly two, and we are inclined to think three, distinct types: to wit, the fine, tall, straight-growing one, which is found over considerable areas; next the somewhat less good, but still fairly well-grown type; and lastly, the very poor, open, badly grown, crooked, stag-headed type. It would be manifestly absurd to prescribe one and the same plan for all three.

Further, we notice that these types occur often over considerable areas at a time, and are usually found also on characteristic situations and soils.

Thus, the best type is more usually found almost purely on the lower well-drained slopes of the hills, where the soil is deepest and richest, and in the undulating plain country.

The mediocre type is found, with slight admixture of other species, a little higher up the slopes, where the soil is somewhat shallower, or on less well-drained situations, while the worst type is that towards the upper higher slopes of the hills, on stony shallow soils, often mixed with a large proportion of other species, and in low-lying, damp, water-logged soils.

It indeed becomes a question whether one method can be made applicable to all.

For the present, however, we will suppose that the selection system is to be applied to all three types, as the question of method is outside the sphere of this paper. Accordingly, for the sake of argument, we will take three types as already sketched, depending on local conditions of soil, aspect, and situation.

Each set of woods falling into each type will then constitute a separate working circle to be worked under the same sylvicultural

system, but subject to different working prescriptions. Thus the mature girth of type I (W. Circle I) might be fixed at seven feet. The corresponding girth type II (W. Circle II) would perhaps be six feet, and for type III (W. Circle III) five feet or even less.

In the same way again the length of the felling period in each case would differ. Perhaps for W. C. I it would be fifteen years, for W. C. II twenty years, and for W. C. III thirty years.

The length of the rotation would correspondingly alter in each case. In each W. C. or type there will be several quality-classes, of necessity.

We may indicate these in decimals of 1, the latter representing the standard quality for each type or working circle of a perfectly normal wood, growing under favourable conditions.

The estimates of the other quality-classes will be based on the general condition of the woods especially with reference to height-growth, *density and general healthiness of the* crop, and must of necessity be ocular, and for accuracy will depend on the capability of the local officer to gauge them properly in their relation to the standard quality.

By reducing all the woods of each series to a common denominator we are enabled to approximate the size of the annual coupes in the several sub-periodic blocks so as to equalise more or less the annual yield. The advantage of reducing the different woods to one quality is to enable us, among other things, to calculate only with areas of equal yield capacity.

Thus, suppose we have a sub-periodic block of 1,000 acres, the sub-period being five years; under ordinary circumstances one would put the annual coupe at 200 acres, and having already arranged the sub-periodic blocks so as to give approximately equalised sub-periodic returns, one would rest content.

But following the above method we find perhaps that the above 1.000 acres consists of two quality-classes, one 600 acres with a mean quality figure ·6 and one 400 acres with quality figure ·4, as compared with the standard wood of normal quality 1.

Hence the total reduced area becomes $600 \times \cdot6 = 360$, and $400 \times \cdot4 = 160 = 520$ acres and reduced area of annual coupe $= \frac{520}{5} = 104$ acres.

Consequently the sizes of the coupes in the above sub-periodic block will be $\frac{104}{\cdot6} = 173{\cdot}3$ acres over area of quality-class ·6 and $\frac{104}{\cdot4} = 260$ acres over area of quality-class ·4, and the coupes will be as follows :—

Coupe	No.	1=173·3=173·3	acres.
,,	,,	2=173·3=173·3	,,
,,	,,	3=173·3=173·3	,,
,,	,,	4=80+140=220	,,
,,	,,	5= 260= 260	,,

In other words, instead of merely approximately equalising the yield over each sub-period, we have gone further and divided our sub-periodic blocks into annual coupes of equal yield capacity, thus effecting a still greater gain. The above, if thought too elaborate, may be omitted, as it is not absolutely essential. Or we may content ourselves with two quality or density classes based entirely on number of exploitable trees per acre and on general healthiness of crop.

III. We now come to the most difficult question, the calculation of the normal growing-stock in each of our type-areas, and the formation of proper age and girth gradations.

For the sake of clearness we will suppose the areas of our three types to be respectively 8,000, 40,000 and 32,000 acres.

We will proceed to take type II area as our example:

Here the area (A) = 40,000 acres Length of period (L) = 20 years. *Length of rotation for 6′* Mature tree (average) } = 160 years	The annual coupe $= \frac{A}{L} = \frac{40,000}{20} =$ 2,000 acres and number of age or girth gradations (since one may change the one into the other denomination at will) $= \frac{r}{l} = \frac{160}{20} = 8$; or 9-in. girth classes.

Then the distribution of coupes will be theoretically as follows:—

	Coupe No. 1 (youngest).		(Intervening coupes Nos. 2—19 inclusive.)		Coupe No. 20 (oldest).		
1	year old trees	= 250 acres			20	years old trees	= 250 acres.
21	do	do.			40	do.	do.
41	do.	do.			60	do.	do.
61	do.	do.			80	do.	do.
81	do.	do.		(3′ 6″)	100	do.	do.
101	do.	do.			120	do.	do.
121	do.	do.			140	do.	do.
141	do.	do.		(6′ girth) or	160	do.	do.
	Total ...	2,000 acres.			Total	...	2,000 acres.

Knowing the average girth increments per annum by 9-inch girth classes from sample-plot readings and *ergo* the average age of trees of girths falling into these classes, we can by interpolation by means of diagrams read off girths corresponding to any age we require. Thus in our second type our rotation is 160 years for a 6-ft. tree. The corresponding girth of 100 years is 3′-6″. Consequently, by interpolation, we can ascertain the exact or appoximately exact girths that should correspond to ages of 120 and 140 years, and so on.

We now know, therefore, a very important fact, and that is that in a normal forest the area under first class timber at any time must be 250 acres or one-eighth of annual coupe.

The next point is to ascertain the normal growing-stock on that area, *i. e.*, the number of mature trees per acre.

To do this we must look upon our selection forest from the standpoint of a high forest under the clear-cutting system, for

the two are identical, except that in the former all age or girth-gradations are found pell-mell on the area, while on the latter each gradation is distinct by itself.

Now we take it roughly that the ideally normal growth in a clear-cut high forest, in its oldest gradation, is present to all intents and purposes, when the crowns of the trees, being perfect just touch and no more, that is, when you have a complete, uninterrupted canopy overhead. We do not say that it is absolutely so, but near enough for our purpose. Did there happen to be more or less number of trees the crowns would no longer be absolutely symmetrical, but lop-sided and compressed, or top-heavy, as the case might be.

Well, it seems to us there is no reason why we shouldn't take advantage of this more or less self-evident fact and employ it to solve our problem and determine the normal growing-stock composing the first and other classes in our selection forest. We have, therefore, to measure a number of crowns of ideal first class trees so as to obtain the average crown basal area.

This may be done by actual measurement of the projections of their crowns, or of the projected shadow of the crowns, that of a tree at noon being as near as possible correct.

As a matter of fact any time of the day would do, as the projected diameter of the crown necessarily remains constant, but noon will give almost the true shadow, or we may make an ocular estimate of the basal area of the average first class tree.

Of course we must choose average first class trees with as perfect crowns as we can find. Suppose eventually we find that the mean crown basal area of a first class tree is so many square feet, we can at once estimate the exact number of first class trees having identical superficial crown areas, which represent the ideal or maximum normal number per acre, and which allow of their crowns just touching and no more.

This, then, gives us the approximately ideal number of trees of first class to the acre. Perhaps this is ten. Then we know that at any moment number of first class trees in the forest should be be 250 × 10 = 2,500. Similarly for all other girth classes, the normal numbers per acre corresponding to intermediate girth classes being found by interpolation

Here we have a definite basis, if a somewhat rough one, to start from; at least a sufficiently solid foundation on which to build our superstructure.

To continue our concrete example, we will suppose the normal numbers per acre in II class to be 12
III „ „ „ 17
IV „ „ „ 20

which is the same as saying our normal growing-stock of II class trees should be 250 × 12 = 3,000
250 × 71 = 4,250
250 × 20 = 5,000.

It is, of course, a matter of opinion how far we may elect to go down the scale, but as far as we are concerned four classes will probably be sufficient as the lower classes may reasonably be expected to be sufficiently numerous to be able to work out their own salvation provided only they are judiciously thinned at intervals, which thinnings will depend on local conditions of soil, time, place and market.

Then theoretically in each annual coupe the possibility will work out to-

$$\begin{array}{ll} 250 \text{ by } 10 = 2{,}500 \text{ I Class trees (final yield)} & \\ +250 \text{ by } (x-12) \text{ II Class trees} & \left.\begin{array}{l} \\ \\ \\ \end{array}\right\} \text{Intermediate yield.} \\ +250 \text{ by } (x'-17) \text{ III Class trees} & \\ +250 \text{ by } (x''-20) \text{ IV Class trees} & \end{array}$$

Where x, x′, x″, etc., represent average actual growing-stock per acre (in numbers of trees) in classes II, III, IV, etc. respectively. Here let $x = 10$, $x' = 20$, $x'' = 24$. In other words, Class II is in deficit and Classes III and IV in excess of the normal, and Class I may be in either.

For our present purpose we consider trees below Class IV (*i.e.*, 3′ 9″ to 4′ 3″ girth) as unutilisable, and whether thinnings or not are to be made in lower classes, we would leave to the discretion of the operator, who may settle the question on economical or sylvicultural grounds to his own satisfication.

Theoretically we say, but practically this is what happens. Our period is twenty years. We institute a thinning every ten years, *i.e.*, at half the period. We take out all our first class trees in our final felling, except any we may be compelled to leave for purely sylvicultural reasons. We are at liberty to remove in addition—

No. II class trees as we are already short in this class to the tune of two trees per acre, or 500 on whole area under Class II.

3 III class trees } per acre.
4 IV " "

But there are accidents of nature to be discounted and forestalled, for much may happen in twenty years.

We must therefore leave a "margin of safety" as a safeguard against the *unexpected*, as well as leave *extra numbers* in classes III and IV, to make up the deficiency in Class II eventually.

We cannot remove any second class trees, as we are short of them already, only we should, if necessary, take out any that are dead or dying, which cannot possibly remain sound till the next period.

We remove then, say, in our first thinning, simultaneously with the major felling, perhaps only 500 third and second class trees, and after ten years (*i. e.*, half period) another 500. Of ou rse the actual numbers or proportion to be removed must be

determined by circumstances and experience. We are altogether 500 in deficit in Class II, and 1,650 in excess in Classes III and IV.

Hence we may remove in our two thinnings just as many of the 1,650 as will leave sufficient to make good this 500 deficit eventually. Here we allow 650 to replace the 500. In other words, we adopt a graduated system of proportionate fellings.

There is one other supposition, and that is where possibly the actual number of trees of each and every higher class is less than the normal number, as in the case of a wood badly over-cut. In such a case we must forego cutting green trees at all in those classes, and must leave a larger proportion also in the next lower class or classes to make good this deficiency in time.

The actual growing-stock can be found by actual enumeration over the whole or a portion of the area, or estimated by means of "sample plots" or linear surveys. Where outturn statistics are available as here, we may calculate our main yield by classifying areas felled over into type classes, and dividing the outturn of these areas by area of each type class which will give an average outturn per acre for each type. If we wish to show our yield in cubic feet we may consider the normal growing-stock as being equal to the volume of the oldest age-gradation multiplied by half the rotation, or the mean current annual increment which we must take to be equal to the mean final annual increment multiplied by the whole growing-stock multiplied by half the rotation. Our final mean annual increment here is $\frac{6}{160}$.

Then normal growing stock $rGn = \frac{I x n}{2}$ where r = rotation and I = the age of the oldest age-gradation. Now the oldest age-gradation consists as seen of 2,500 trees (the normal number), and from experimental fellings we know the average first class tree yields 'a' cubic feet.

Then $rGn = \frac{2{,}500 \text{ xax } 160}{2} = 2{,}500 \text{ ax } 80$ c. ft.

or $= \frac{i \times n \times 160}{2} = i\ n \times 80$ c. ft.

Where i stands for the final annual mean increment, or current annual increment, as the case may be, and n the total number of trees of all classes and ages in the forest—n can be found from results of direct enumeration or other estimated survey, and from sample-plot annual increment readings. Or we can give our normal growing-stock in number of trees. Here we are obliged to admit a fallacy, but not, we think, an irremediable one. It is, that we are taking the growth of sal to be uniform throughout. This is not the case of course; the rate of growth varies at different periods or stages of its life-history, now faster, now slower than the average normal final annual increment on which we have based our calculations.

The remedy again is not far to seek. It lies in allowing a greater margin of safety in the slower growing periods, and less in the faster.

This again is a matter of circumstance and experience.

With this to guide us we should very soon get a fair estimate of our forest as it stands in relation to the normal forest, and pick our way accordingly.

It may be said that in practice the difficulties would be great because you must remove badly growing trees over promising younger stuff, and this will put your proportions all wrong. To get over this, it must be made a rule only to cut up to the maximum and then stop, and if any badly grown trees remain, it cannot be helped. Most of the lower classes will, as a rule, be so numerous as not to matter much, and one may leave them to compete on nature's lines and to do their own thinning, looking only to the final result, which will be the survival of the fittest.

Of course one would start on the badly grown trees, and only go on to the good ones if it was necessary to make up one's numbers.

Our example is necessarily an impossibly ideal one, but it is the principle that is the thing. Experience alone can determine the extent to which it can be developed in actual practice, if at all.

In time, as the forest itself, the girth or age-gradations, and increment became more normal, the lower classes would almost of necessity fall into line automatically.

Lastly, with regard to the question of thinnings or improvement fellings, that is subsidiary or auxiliary fellings as opposed to and distinct from the major or selection fellings. That some such periodical thinnings will be necessary, nobody will deny, but their nature and extent is yet to determine. We have suggested that there should be two per period. The first simultaneously with the major felling, and the second at the expiry of half the period, or, in the case of a longer period, every ten years. This would be for convenience and economy in working.

Better do away with the name "improvement fellings" altogether; the term is to be distrusted, since in unscrupulous hands it has shown itself to be capable of many and exceeding vagaries, and instead institute "weedings" in the younger, and "intermediate thinnings" in the older classes. That is, "unutilisable" stuff would fall under the former, "utilisable" material under the latter, if it is wished to define them sharply.

With regard to these weedings the material that comes out will be unsaleable as a rule, and so it will become a question whether the superfluous trees in the lower classes should be removed as a cultural operation, or whether we should not omit them in the lower classes, leaving these to nature's thinning, and only commence operations in those capable of giving some utilisable, *i.e.*, saleable material.

This must remain a problem for the economist.

But from the late Mr. Dickinson's tables there can, we think, be little doubt that judicious thinnings in young sal forests are undeniably sound sylviculturally.

The difficulty of estimating the effects of these thinnings will increase as we go up the scale, and we should attain *Au comble* when we come to the II Class, for there must always necessarily be immense difficulty in applying proportionate thinnings to a forest worked under the selection system, with its irregular-aged woods, as compared with the simpler, more regular, even-aged classes of more regular systems. For it is comparatively easy, or should be, to determine in regular even-aged woods that at a certain age such or such a percentage should remain or be cut out of the whole, but in uneven-aged selection forests, where all sizes and ages are represented pell-mell on the ground, there will be much more liability to error in determining what percentage of each must remain or come out, as no one acre, probably, has quite the same proportion of classes on it, and the effect of removing trees is not so marked as in even-aged woods where the trees are approximately all the same height. Still, while admitting this difficulty, we do not consider it to be insuperable.

As to the intensity and extent of these thinnings, we must proceed with caution, and it will be advisable to err on the side of leniency, that is, of light thinnings, till we are in a position to lay down the law. We should be sure to leave a sufficient margin of safety to meet every conceivable and possibly inconceivable contingency, or mishap. The margin of safety should be determined, in the first place, by the healthy appearance or otherwise of the trees in detail and of the class as a whole.

Thus if it appears likely that the 17 trees in class II selected as the "trees of the future" may reach maturity safely, we may remove 2 and leave 1 as our safety figure, and at the end of ten years remove it or not as we think fit.

If, on the other hand, some or all are unhealthy, we should increase our margin of safety proprotionately, and remove all the rest.

Of course at the outset the results can hardly help being approximate, but as time goes on, experience is gained, and more data become available, gradually things will be brought to a sufficiently correct standard beyond which we cannot hope nor wish to go till we are in possession of accurate yield-tables. So much for intermediate thinnings, as they will be termed.

The advantage we claim for this system, if it is worthy of the name, is that no matter whether the actual growing-stock is too little or in excess, by a careful application of these rules we cannot fail in the end to establish more or less normal conditions, and therefore a normal growing-stock.

We seek to establish a normal increment and normal girth gradations, the natural consequence of which must be that

the growing-stock will fall into line ultimately and become normal.

Where any class is deficient in numbers, then all except dead and dying trees should be left if necessary, and if it comes to the worst a few even of the I class trees, the more healthy of them, that is, may be left if in excess of the normal numbers, to make up for the deficit which would otherwise come in the next period.

During the first period the final yield may not be normal, but it will, at least, approximately be known beforehand.

With each successive period the final yield should approach nearer to normal conditions, and each time the final yield will more and more nearly approximate to the normal final yield, though of necessity the intermediate yield must always vary considerably between limits.

We cannot, therefore, associate ourselves wholly with the view that proportionate fellings can find no place in half-ruined forests, though doubtless this view is correct in the broad sense. They seem to us, if properly applied, to be equally applicable anywhere, though with modifications.

Of course there are various cases where a divergence will have *to be made.*

Thus in areas where young growth is absent we cannot of course apply our proportionates fellings or intermediate thinnings —nor any other sort of fellings for the matter of that—blindly, and a *sine qua non* must be that regeneration is thoroughly established before we proceed to remove the stock automatically, regardless of the future.

To recapitulate: we take as an undisputable axiom that no working plan can be sound theoretically which fails to institute a comparison between the actual and normal growing-stocks of a forest.

From this we deduce three main maxims, namely—

1. The creation of a normal growing-stock.
2. A sustained annual final yield.
3. The utilisation of the annual increment.

From this we proceed to lay down the following principles or objects:—

(*a*) Over-cutting to be made impossible by fixing the minimum girth of mature trees.

(*b*) Different prescriptions for different parts (often overlapping of a forest of one species growing under a variety of conditions.

(*c*) The essential grouping of several coupes into sub-periodic blocks, so as to equalise the outturn, combined with the desideratum where possible of a more or less equal annual coupe, while permitting one to meet sudden fluctuations of the market (*viz.*, rise or fall in demand).

(*d*) Under-cutting to be avoided by periodical judicious "intermediate thinnings" with margin-of-safety checks against over thinning.

(*e*) The formation of girth or age gradations and the execution of proportionate fellings.

(*f*) The separation of weedings (cleanings) and thinnings in the auxiliary fellings.

(*g*) The thinnings to be two per period, the first simultaneous with the major felling, and the second at the end of the half period, or at 10-year intervals.

Having had our say, and built up our "Castle in the Air," it only remains for some unkind critic to demolish it, or prove it is only a mirage of the brain after all. In which case will we plead guilty, but not before.

"MORE LIGHT."

Reproduction by Root Suckers.

I was much interested in Mr. A. W. Lushington's article on the subject of reproduction by root suckers or sucker shoots as he terms them, which appeared in "The Indian Forester" for April, especially as this is a subject that has been engaging my attention for some time; and I quite agree with him when he says "It is rather surprising how little attention is paid to the subject and that it does not appear to have met with as much recognition as it would seem to deserve."

This interesting mode of reproduction first attracted my notice some years ago when serving in Upper Sind, and in writing the Administration Report of that Province for the year 1893-94 (reviewed in the "Indian Forester," pp. 56—63, Vol. XXII) opportunity was taken to allude to it in the case of Populus Euphratica.

In this instance the reproduction in the alluvial plains of Sind was distinctly a benefit, both natural and artificial regeneration from seed of this species being obstructed from some cause or other, at least such was the experience acquired at that period. In the case of several species in the Thana district, however, reproduction does not possess the same value. Many species throw up abortive shoots only from their roots, while others instead of proving beneficial by the possession of this aptitude seem to be distinct hindrances to the natural regeneration from seed of more valuable trees.

In connection with Populus Euphratica the Conservator of Forests in Sind once directed the firing of a portion of the Kudrapur Forest in Upper Sind in order to give a spur to the reproduction from root suckers of this species, and the measure as far as my recollection goes was a distinct success.

TEAK REPRODUCTION BY ROOTSUCKERS.

Photograph by Ranger Bhudbudi—Thana, Bombay.

The heat caused by the burning of the grass it was found, stimulated the subterranean buds into activity just as it does in the case of the rhizomes and roots of some strong grasses and weeds.

It was not an uncommon occurrence to find numerous suckers 30 feet distant from the parent tree after a fire in the riverain areas in Upper Sind, all of which ultimately acquired a separate and independent existence by the decay and death of the original connecting roots, and a gregarious forest of Populus Euphratica was the result. Somewhat similar stimulus to the buds on the roots has been observed in the case of Diospyrus melanoxylon under the same conditions in Thana in parts of the Mokahada Range, and a most interesting and remarkable instance of such reproduction was brought to the notice of Mr. Duxbury, Working Plans Officer, recently on what is known as the Awlmatha near Suryawal in Mokhada. To a casual observer here the reproduction might have been thought to be from seed. Such it was declared to be in fact by the local patel and Forest subordinates when first it was observed, but excavations were made for their benefit, and the root system of the younger suckers exposed.

The following, excluding herbaceous species, have up to date been noted in Thana as producing root suckers :—

Teak.
Dalbergia latifolia.
Ougeinia dalbergioides.
Albezzia lebbek.
Albizzia melanoxylon.
Schleichera trijuga.
Schrebera swietenioides.
Trewia nudiflora.
Pongamia glabra.
Garuga pinnata.
Butea frondosa.
Randia dumentorum.
Aegle marmelos.
Croton oblongifolius.
Ficus hispida.
Randia uliginosa.
Holarrhena antidysenterica.
Helicteres isora.
Vitex negundo.
Calycopteris floribanda (climber).
Combretum ovalifolium (climber).
Schrebera swietenioides.

Teak reproduction from root suckers is most interesting in parts of the Thana district. Near the town of Wada in Central Thana an area outside forest proper is covered with teak coppice shoots and also root suckers. The latter are much smaller than

the coppice, and in many instances resemble seedlings.* In traversing this area I was struck with the abundance of such reproduction, and dug up the root system of some apparent seedlings to make sure. The accompanying photograph is one taken in this area exhibiting the root systems of three teak shoots which are connected and which originally resembled independent seedlings. In their case the connecting subterranean roots are still visible, but in the case of older shoots these connecting links as it were, like the poplar in Sind, entirely disappear, and this is the case with most species, so that when digging up the soil in search of root suckers one must not be disappointed in the case of older stems to find no connecting subterranean links at all.

In Europe the Aspen (Populus tremula) and the tree of Heaven (Ailanthus glandulosa) and some others† are known to reproduce themselves by means of root suckers, and the buds on the roots of these are stimulated to throw up roots apparently either by the mutilation of the aerial portion of the stem or exposure of some of the root system or by the trees having become decrepit with age. The latter stimulus has been noticed in Thana in the case of—

Schrebera Swietenioides, Albizzia procura, Dalbergia latifolia, Pongamia glabra and Schleichera trijuga.

An interesting instance of reproduction owing to declining age in the case of Schrebera Swietenioides may be seen near Parali in the Wada taluka of Central Thana‡ where four large stems (girths 2′, 1″, 1′ 4″ and 1′ 4″) and two smaller ones a few feet high stand in a circle around the parent bole at a distance of 9 to 10 feet from it, and with regard to the other species instances are common especially in the hilly forests in the Bassein Range which skirt the sea coast. And this reminds me to remark that conditions of climate and soil have a varying effect on the powers of reproduction of a tree from root suckers. Relative abundance of humidity in the atmosphere for instance seems to provoke reproduction in the case of Dalbergia latifolia§ whereas the very opposite effect seems to follow under the same conditions in the case of Schrebera Swietenioides, that is to say, Dalbergia latifolia has been observed to exhibit a greater tendency to throw up root suckers in a relatively moist than dry climate, and Schleichera trijuga exhibits such increased tendency in a dry atmosphere only. And with regard to soil it can be readily understood that where this is soft less obstruction is caused to lateral expansion of the roots and the

* In coupe No. 6, Block XVII of Wada, I ordered the subordinates to make an enumeration of the number of teak seedlings of 12-inch girth and under in the area (42 acres), which they did, and to my surprise over one thousand were reported to exist. On inspecting the coupe, however, the apparent seedlings were dug up and found to be none other than root suckers.

† Kerner in his "Natural History of Plants."

‡ Block No. XXIV, coupe 22.

§ Other species such as Holarrhena antidysenterica, etc., are similarly affected.

greater development in this direction takes place, so that when any stimulus is given to the buds from any external cause, such as shock caused by heat or injury to an exposed root, increased reproduction by means of root suckers is apparent in such causes.

Avicennia officinalis, which grows along the muddy tidal banks of the Konkan creeks, spreads its roots laterally below the surface of the soil in all directions, and although numerous buds exist on these roots, and although the resulting shoots therefrom are as dense almost as a field crop in some instances, none of the shoots develop any foliage. They become rigid and seem to perform the function of producing air passages to the roots for the moist clayey soil being impervious to air.

No means of respiration for the roots would result otherwise, and the *Avicennia* would probably be suffocated.

The most prolific instances of reproduction from root suckers observed inside and outside forest are of Holarrhena antidysenterica, Trewia nudiflora, Helicteres isora and Randia uliginosa, and their reproduction in this manner may be characterised as being distinct hindrances to the natural regeneration from seed of other valuable timber species in the localities they inhabit. None of the above species is prized for its timber, and their reproduction in this manner is so abundant, especially when their aerial portions have been mutilated (as is always the case in the coppice-with-standard system), that exclusion of more valuable species from seed results.

In some of the exploited coupes in the Bassein Range the intervening spaces between the standards in certain localities are almost entirely usurped by Holarrhena* especially, and the reproduction increases in even greater ratio as the fellings or coppings of the species increase.

A very remarkable instance of reproduction from root suckers in the case of Trewia nudiflora is noticeable in Coupe No. 19, Block XIX, of Bassein, and it is worthly of record. A large part of the coupe on the flat consists of mature teak. In passing through this area the abundance of advance growth of Trewia under the teak (in a small area of a few acres) attracted my attention, and not being able to account for this I was induced to investigate the cause, and on digging up the roots of Trewia found the reproduction to be due to none other than root suckers. The roots of the Trewia formed a complete network underground, and their density naturally accounted for the exclusion of everything else except surface growth, such as grass and weeds. This was in an area where the mature crop consisted, it is estimated, of about 80 to 90 per cent teak. The reproduction of Helicteres isora is also another instance of similar remarkable reproduction. This is a shrub that is widely distributed in the

* *Coupe 14, Block XIV, at Saticoli is a very good instance of this. Being* only three miles from the Bassein Road Station, it is easily accessible for inspection.

Thana district and common in the seacoast talukas especially. Its bark is used, as is well known, for fibre. Hence it is a shrub which is invariably seen lopped, and the more its aerial portion is mutilated the greater is the stimulus afforded to the dormant subterranean buds.

On the eastern slopes of the forests below the Tungar Plateau in Bassein such reproduction on the soft laterite soil is most abundant. The buds on the roots of Randia uliginosa seem to be stimulated without any apparent injury to be aerial portion of the stem or injury to the roots. A great deal of reproduction of this species is apparent in the flat, fissured black soil areas in the Wada Taluka of Central Thana.

The necessary stimulus to the subterranean buds in this instance appears to be heat, due to the exposure of the root system caused by the cracks in the black soil.

Albizzia lebbek is not a tree which has been noticed to throw up root suckers habitually, but a very interesting instance of such reproduction occurring on the exposure of the root system came to my knowledge recently in the Wada Range, where 21 Albizzia lebbek suckers were observed in some excavated pits arising from roots which were imbedded to the depth of $1\frac{1}{2}$ feet in the soil. A close examination proved that these suckers arose from a network of subterranean roots which spread out from an Albizzia lebbek 100 feet away.*

Among the species in Thana observed so far whose reproduction from root suckers may be said to be advantageous in certain areas are Dalbergia latifolia, Albizzia procera and teak.

The two former species throw up such shoots when either the aerial portion of the stem has been mutilated or when an advanced age has been reached, and in the case of teak the reproduction is stimulated only when the aerial portion has been cut down and when the trees stand on a plot exposed to full illumination of the sun's rays. Albizzia procera, which usually seeds abundantly, does not reproduce itself well from seed. This may be due to a cause which I have not investigated, but probably to insect damage. Seeds of Bauhinia recemosa, Albizzia lebbek and certain other leguminous species have been found very extensively damaged in this way, and specimens of the injurious insects were sent to the Forest Entomologist for identification. Probably the failure of reproduction in the case of Albizzia procera may be due to some similar cause. Teak seed also is attacked by an insect which obstructs its reproduction. The damage to the seed from this insect appears to be

* The Aspen according to Kerner has been known to throw up root suckers 90 feet away from the parent tree. The Albizzia here alluded to may be seen in Coupe No. 14, Block XXIV, Wada Range, and will probably be open for inspection for many years to come, for beneath it stands a Hindu deity (Vagoba), which will prevent it being felled or damaged.

general all over Thana and amounts to about 60 per cent of the tree growth in most localities and from 5 to 90 per cent per tree.*

So far observations do not show that Babul (Acacia arabica) reproduces itself in Thana by means of root suckers, nor has this been observed to be the case with this species in Sind, where it forms large gregarious forests, aggregating about 65,000 acres. This was the approximate area under Babul in Sind about ten years ago, but it may have altered since owing to the eccentricities of the Indus, which sometimes erodes hundreds of acres of forest land in a flood season. Nor does Babul coppice, at least not in the ordinary sylvicultural acceptation of the term, in Sind and the Thana district, at any rate. Some young stems when cut have been known to throw up abortive coppice shoots, but marketable coppice in Sind and in Thana would be considered a remarkable phenomenon.† Enough has been said to show that the interesting subject of reproduction from root suckers in the Thana district is one which ought to engage, as Mr. Lushington has remarked, the attention of Forest Officers. That it is one cause for the hindrance to natural reproduction of more valuable species such as teak in some of the Thana coupes, in the hilly forests especially along the the sea coast, is beyond doubt, as I have attempted to show. On the other hand, in other areas more inland where teak and other growth have been once exploited and where the former has coppiced its regeneration from root suckers at the same time cannot be said to be but advantageous. The direct causes which bring about this result, as already explained, seem to be first of all shock due to the felling of the aerial portion of the stem and complete exposure of the surrounding soil caused by the previous removal of all jungle wood species,‡ but as such sylvicultural conditions do not always prevail within forest limits the phenomenon is not constantly observable in such limits.

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* In some cases while the tests were being taken trees were found to bear no seed at all. The experimental tests were not taken on a very large scale, only 24 trees being examined at haphazard as I marched through the forests. It will be found however, it is thought, that the percentage of damage is a fair average, and that it is general all over the districts there is little doubt. From what the people say moreover the insect attacks are annual.

† I am aware that in Guntur, *vide* page 256, Vol. XXI, of the "Indian Forester," babul is found to coppice there. In Mr. Ribbentrop's Note also on the Babul Plantation at Abbaspur, page 136, Vol. XXVI, he states "a coppice growth of several rotations might be expected." He suggested in the Note the publication of details bearing on the behaviour of the root system of this plant in the "Indian Forester," but I have not seen any subsequent report on the subject.

‡ In the Thana district almost everywhere the villagers are permitted to fell and remove in the wooded areas held in occupancy by them all trees, etc., except teak and Dalbergia latifolia, and in some places Ougeinia dalbergioides, so that where these fellings have been carried out teak reproduction from seed and coppice and root suckers is very materially assisted.

In mixed forest with a relatively dense leaf canopy, for instance, where the soil is comparatively cool such reproduction has not been observed. Another important feature though of such regeneration is that it seems to occur where the ground is bouldery and at the same time porous beneath. The root suckers, however, never appear to be at a greater distance from the parent bole than 3 to 5 feet; whereas in the other species such as Albizzia lebbek, Albizzia procera, etc., the distance, as already stated, is considerable.

In the discussion on the subject of teak natural regeneration in "The Indian Forester," which I have read with much interest, the hindrance to such reproduction from insect enemies has not, as far as I am aware, been recorded, and it would be interesting to know whether similar obstruction is caused elsewhere in either India or Burma. It appears to me to be a factor in the situation in Thana which must be taken into serious consideration. The wild tribes in the district I find are fully alive to the damage caused by the insects to the seed, which they have informed me bore into the seed during the monsoon when it has become well soaked. But I have detected insect damage to seeds collected from the trees, so that this is not altogether correct.* Mr. Duxbury informs me that coupe contractors have told him that "the teak seed is seen damaged on the tree when soft and succulent, and that they considered, like the mango, that the life-history of the insect has some connection with the flower before it was fertilized."

Endeavours are being made to try and secure specimens of the insect, which will be sent to Mr. Stebbing if obtained.

Infertility of seed obtained from coppice stems in the exploited coupes is found to be another cause for the failure of natural reproduction of teak. It is true the coppice has not yet reached more than 15 years at most, but it is important to record that experiments to cause germination of seed from such growth so far have been in progress since September 1903, but without successful results.

Mr. Burkill, Reporter on Economic Products to the Government of India, very kindly undertook such experiments for me, and his last report, dated 14th June 1904, bearing on the subject, it may be interesting to record, is as follows :—

"The experiments on teak seeds have never been interrupted. Since September last the 100 seeds have stood on the tile always moist, but not one has germinated. The flesh outside the stone is black and rotted and moulds are growing on it sparingly. I have just cracked open ten fruits. Out of the possible 40 seeds in them three seemed possibly alive, very wet and damp. Out of ten fruits which have been dry all this time I got some five or six healthy seeds."

* Mr. Bhadbhude, Ranger of Wada, was the first Forest Officer to observe the damage to the seeds while on the trees.

I have observed teak coppice bearing seed at eight years, and as this seed is probably often collected by Forest guards for broadcasting it can be easily understood why such attempts at artificial regeneration of this species, added to the other hindrances remarked on, fails.

There is of course some natural regeneration from seed of teak in certain areas in Thana, but not by any means sufficient in far the majority of instances, it is alleged, to secure the future of the forests for the production of teak on a satisfactory scale.

In this view I am corroborated by Mr. Wroughton, who, in the Northern Circle Annual Report for Bombay for 1894-95, which was reviewed in the "Indian Forester," page 389, Volume XXIII, wrote as follows *:—

"The 'coupe' system, as it is popularly called, under which the Thana forests are being worked, is in most ways a complete success. The people are furnished with rab-material and a livelihood and the revenue remains at a high figure; moreover, the coppice shoots from stools felled promise a fair crop for the next revolution, but it cannot be overlooked that there is a great dearth—too often a total absence—of seedlings to replace the present stools when their reproductive power shall be exhausted. The vitality of the present stools may last out two or even three revolutions, but unless seedlings are produced to replace them as they fail, the ultimate result must be denudation."

Being in charge of the Central Thana Forest Division, my remarks in this note of course must be taken to allude especially to that division, but it is believed they would be applicable generally, like Mr. Wroughton's remarks, to the other two divisions of the Thana district.

It is but right to mention in conclusion that my observations about the alleged unsatisfactory condition in Thana as regards teak regeneration from seed † are not borne out by such authorities as the present Conservator, Mr. *Millett*, nor by the two Divisional Officers of North and South Thana, Messrs. Fisher and Madan, and I am induced to think that perhaps where they observed an abundance of advance growth of teak in the exploited coupes of their division it may have been root suckers which were seen and not teak seedlings. Mr. Fisher in fact has informed me that most of the teak reproduction he observed in North Thana was mainly in the exploited coupes, and that very frequently the young teak has been seen growing in groups and as if burnt back more than once by forest fires, which would tend to indicate root-sucker reproduction.

* Mr. Wroughton attributes the failure of natural regeneration from seed to forest fires, and although he does not differentiate between teak and jungle wood species, his remarks are intended to apply no doubt more especially to teak, which is the main source of wealth of the Thana forests.

† Natural regeneration from seed of jungle wood species is in my opinion generally satisfactory in Thana; in fact in instances it tends to suppress the teak.

In addition to the hindrances to teak natural regeneration from seed which I have quoted, there are of course other causes at work in the same direction unfortunately which are too numerous and lengthy to enter into it in a paper of this description, which was intended originally to record observations bearing on root-sucker reproduction. I have however, as it is, much exceeded the limits of the subject, and seek indulgence on this score.

G. M. RYAN.

Old Cooper's Hill.

Peculiar, if somewhat sad, interest was attached to the meeting of Old Cooper's Hillians at dinner on July 13th last, for it was the first assembly after receipt of the mournful news that the Old College had heard its death-knell, had received its *coup de grace*, and knew that its days were numbered. *Sic transit gloria mundi!*

The dinner, arranged by Messrs. W. H. Cole and A. Hicks, was all that could be desired, and was discussed with zest by a party of between 60 and 70 men, O. C. H's, and their guests. As one glanced round the tables one could not but silently agree with a remark, made later on in the evening by General Edgecombe, on the youthful look of the greater majority of those present, a youthfulness not due so much to age of the men (for the seniors were in great force), but undoubtedly more particularly attributable to the active life which the performance of their duties, entailed upon the greater number of those present. There are some who say that health in India is to be sought by taking the minimum, the irreducible minimum, amount of exercise whilst serving in the country. Could they have seen Cooper's Hill the other evening they would have seen that a hard active life appears to suit the men from the College on the Hill marvellously well.

The Chair was taken by C. Perrin (1874), the chief guests being Major-General Edgecombe, R. E., Professor H. McLeod, F.R.S., and Colonel J. Pennycuick, C. S. I., with Messrs. J. S. Beresford, C.I.E., J. H. Glass, C.I.E., Mr. G. Chesney, &c.

After the toast 'The King-Emperor' had been duly honoured, S. Debrath (1877) proposed Cooper's Hill in a speech studiously moderate in its language. Indeed this was the predominant note of the evening, and should prove to Government, if proof at all were necessary, that such an Institution as the College is the ideal at which to aim to ensure the proper training of its future officers, for at it they learn three important things—never to be forgotten in after service—*esprit de corps*, discipline, and loyalty to the Government they serve. In spite of the surprise, the sorrow, the irritation, to call it by no worse name, with which the recent order has been received throughout the rank and file of Cooper's Hill men, all of which feelings could not but be perceivable the other evening, those three fine qualities, *esprit de corps*, discipline and loyalty, were not for a moment forgotten. It was an object-lesson, and an object-lesson of which any Government might have felt proud to find in a body of its servants.

The speeches were optimistic and pessimistic, and perhaps, as was only natural, the optimists were to be found among the ranks of the younger orators. Both Debrath and F. Rawson, C.M.G. (1878) were optimists, and, on the principle of never saying die until you are an inanimate corpse, they held that with two years in hand, with Governments and Secretaries of State who have both been known to change at times, both occasionally suffering the fate of more lowly mortals, the ignominious one of being 'kicked'

out; and, above all with a Viceroy who is known to possess both a strong will and great tenacity; counting over all, these points our optimists sounded the note of hopefulness and inclined *to doubt that the curtain would be rung down* in the near future on as grand an institution as Government have ever planned and reared. Amongst the pessimists were Colonel Pennycuick and Mr. Chesney. The former, whilst saying that it was the dearest wish of his heart to see Cooper's Hill kept on, could not see his way to holding out any hope that this would be the case. It was easy to see from the Colonel's speech and those made by General Edgecombe and Professor McLeod (both the latter of whom were on the Staff at its inauguration) what a great hold the College has upon the affections of them all. Love for the *alma mater* was much *en evidence* throughout the evening. I have said that Mr. Chesney was a pessimist, and sorry many of us were to hear that he was so, for the *Pioneer* has ever been a faithful friend to Cooper's Hill. In a lengthy and highly interesting speech Mr. Chesney gave reasons for considering, for fearing, that Cooper's Hill was doomed, interspersing his remarks with anecdotes of the days when his father was the first President of the College, for the present undoubted pitch of perfection of which we owe to the great administrative qualities of the man who was its founder. In the course of his speech Mr. Chesney, who may be said to represent outside public opinion on the recent decision, showed that that opinion coincided closely with that of the services affected by the coming change. Letters regretting their inability to be present were received from Sir John Otley, K.C.I.E., Dr. Schlich, C.I.E., F.R.S., &c., whose absence was not perhaps, under the circumstances, surprising.

A wish was expressed before the assembly closed that, whatever the eventual fate of the College, the Cooper's Hill Dinner might be continued for many years to come, and that the Cooper's Hill *esprit de corps* might grow the stronger as years rolled on. One can but re-echo the wish. F. J. Branthwaite, B. O. Coventry, F. H. Todd, and the writer were the Foresters present.

E. P. STEBBING.

Bassia latifolia and Bassia longifolia.

Although Mhowra seed is being exploited in parts of the Central Provinces and parts of the United Provinces, it is necessary to point out that this produce is not forest produce under section 2 [2] (a) and (b) of the Indian Forest Act. It is, as will be seen by a reference to the Act, omitted from mention among the various articles enumerated therein. *Mhowra flowers* are mentioned only in the section. Would it not be desirable to amend the Forest Act under the circumstances?

Owing to certain representations made on the subject of the market value of Mhowra seed, the Bombay Government were

induced to order the Departmental collection of it in Thana this season. Unfortunately, however, the locusts, which were a perfect plague almost all over the district during the dry season, defoliated the Mhowra trees more than once in some instances, and prevented the flowering of the tree.

Those trees which escaped defoliation or were only partially defoliated, flowered and seeded but scantily, due to a profuse flowering and seeding of the trees the previous year. The exploitation of the seed will probably be undertaken next season (1905)

The question arises whether Bassia longifolia seeds should not be exploited as well as Bassia latifolia. This question has been raised by Mr. Cowley-Brown, who points out that Bassia longifolia and Bassia latifolia bulk very largely in the Nallamalai forest of the Kurnul district, Northern Circle, Madras, a block of 2,000 square miles of forests.

Sir Dietrich Brandis in his "Flora of N.-W. and Central India," page 291, mentions that from Bassia longifolia seeds oil is extracted, and in a small work by F. N. Mukerji of Calcutta entitled "Handbook of Indian Products" it is stated—

"The oil obtained from the seeds is used as a lamp oil, in the manufacture of country soap, and as a substitute for ghi (clarified butter) and cocoanut oil in cooking curries and making sweet cakes. Dr. Balfour states that the seeds contained about 30 per cent oil."

Bassia longifolia is not found in the Thana district, and as I have never seen the seeds and know nothing about them I am unable to give an opinion as to their value for export purposes; but it seems if the seeds are not now exported from any locality, as is probable, it might be advantageous to encourage the export of the produce by making an experimental shipment of say a ton, in order to test its market value. This is suggested since the seeds from Bassia latifolia appear to be inadequate to meet the existing demand, judging by information to hand from merchants in Bombay, and probably as far as merchantable requirements go, Bassia longifolia and Bassia latifolia seeds are very similar.

In parts of the Central Provinces the Commissioner of Settlements and Agriculture, Mr. Sly, I. C. S., has brought to notice the fact of the absence of natural reproduction of Bassia latifolia, and also the danger of the early extinction of the mature trees there, owing to the attacks of the Loranthus parasites. In view of the great value of the Mhowra flowers as an article of food he states that the future outlook of the tree is serious, and he seeks for information as to the best means to arrest the latter damage. I have supplied, through Mr. Lawrence, I. C. S., the Director of Agriculture, Bombay, whatever information I possess on the subject, but probably there are other Forest Officers who can also give more useful information, and Mr. Sly I have no doubt will be obliged for any hints.

It was suggested to Mr. Lawrence that the waste lands in the Bombay Presidency might be rendered productive by the artificial reproduction of Mhowra in the Mhowra-producing tracts, and although he approached certain Collectors and the Commissioner of Customs and Abkari, Bombay, on the subject, they were one and all averse to the proposal because the Commissioner of Customs and Abkari writes "So long as the principal use of the products of the Mhowra tree is the manufacture of liquor, any extension of the growth of the tree should be discouraged," and that the only tracts in which it should be permitted to grow are "large, concentrated, thinly populated blocks of forest."

It may be interesting to mention that Mr. Hudson, I. C. S., Collector of the Kaira district, Guzerat, in writing to me on the subject of Mhowra says, "There are thousands and thousands of Mhowra in this district. ... ...The oil expressed from the seed is used locally at Kapadwanj for soap making. There is a press worked by an engine at Thasra, which sends the oil inland to Balasiner and the Rewa-Kanta State as well as by rail."

I suggest that the market value of Mhowra seed be quoted by the "Tropical Agriculturalist" along with the other articles of minor products which that periodical quotes monthly and which is reproduced in the "Indian Forester" for information.

BANDRA:
10th August 1904.

G. M. RYAN.

Fire Protection in the Teak Forests of Burma.

I.

Mr. S. Carr can well look after himself, but as he is away on leave, will you let me answer "Non Burman" for him. Two of his statements are challenged. Let me deal with the second first—"Most of us have suffered considerably in recent years owing to the number of senior officers heaving been transferred from India."

"Non-Burman" seems to think the transfer of Messrs. Gradon, Muriel, Jackson, and Carr far more than counterbalances this. Of the above four Messrs. Muriel and Jackson are the only real Burma officers. Mr. E. C. Carr for the first seven years of his service held such important Burma posts as Changa Manga, Multan, Rawalpindi, Phillour and Lahore, and then as 3rd grade Deputy, Mandalay Direction.

Mr. Gradon's record as a Burma officer is still more instructive—joined the service December 1885; appears first in Burma November 1901 as 3rd grade Deputy.

Again, of the next four quoted only Messrs. Thompson and Burn-Murdoch are Burma men.

Mr. Hill joined the service in December 1887; appears in Burma in January 1896. Similarly Mr. Hodgson joins in December 1890; appears in Mandalay in 1897.

Mr. Manson came to Burma as Officiating Conservator, so he didn't help us much in the way of promotion. But to show Mr. S Carr is right, what of Messrs. Jellicoe, Reuther, Anthony, Rind, Leete and Ker Edie, to only mention some I can call to mind.

A senior man coming to Burma keeps us out of promotion, and after having blocked us for some years, it is really very consoling to be told he has been made a Conservator, or "it's all right; we have taken a Burma man away" when he goes at last.

2. As regards the fire protection question "Non-Burman" says his "remarks must not be taken to apply to areas where there is bamboo undergrowth in teak forests."

In Upper Burma I think most Burma officers of experience asked to estimate the classes of teak forest roughly would say that teak and bamboo covered 80 per cent of the area, 18 per cent teak and evergreen and 2 per cent teak without either (I only refer to forests containing teak at all). Non-Burman ignores the first, but that is the only class we Burma Forest officers need bother about. As regards the teak and evergreen that is naturally fire protected and the teak is surely dying out therein; the teak forest without bamboos or evergreen is so small as to be hardly worth troubling about, though I may here say that such is usually outside protected areas and is annually run through by fierce fires, yet such areas look like very fine plantations, the teak being tall and straight and reproduction excellent; but such areas depend on peculiar factors of soil only found locally and no amount of fire protection will increase them, or is one of the miracles expected of successful and continuous fire protection—the turning of laterite into alluvial?

3. *Might I in conclusion ask "Non-Burman" to be sure of his* facts before giving us dissertations at all.

"TAW KWE."

II.

I see from the "Indian Forester" for August that Mr. Long desires some one to check his mathematics.

As I have just had occasion to deal with a similar problem in my Annual Report for 1903-04, and the solution is quite simple, I send him the correct answer to his problem. It is Rs.1,14,333.

$$\text{The formula is } A = P.R.\frac{R^t - 1}{R - 1}$$

Where A = Amount at the end of the period.

P = Annual expenditure.

1·or = R = Amount of Re. 1 at the end of one year.

T = Number of years.

R = Rate of Interest.

SEONI-CHAPPARA:
6th August 1904.

N. C. M.

Canadian Forestry Association.

I have received a Circular from the Honorary Secretary of the Canadian Forestry Association with a view to increasing the membership of that body, widening its sphere of influence, and collecting and disseminating such information as will enable its membership and the general public to appreciate and understand the Forestry problems which are presented for solution in Canada. The objects of the Association are—

"The preservation of the forests for their influence on climate, fertility and water supply; the exploration of the public domain, and the reservation for timber production of lands unsuited for agriculture; the promotion of judicious methods in dealing with forests and woodlands; reforestation where advisable; tree planting on the plains and on streets and highways; the collection and dissemination of information bearing on the forestry problem in general."

It need hardly be said that the forest question is really acute in Canada, not less than in the United States, and it is a sign of its importance and of the awakening interest that the C. F. A., though only established five years ago, already has some three to four hundred members, including many of the best-known names among lumbermen, officials, both of the forests and other branches of the Administration, and persons less directly interested in the subject. Without offence to these fellow Imperialists of ours, it may be said that the scientific side in the Association is weak. Organisation and protection have been begun in Canada, but other branches are practically unknown or unpractised.

Forestry in democratic countries of great forests is not and never will be run on the same lines as in India, but the general scientific principles remain the same; and officers of the Indian Service who can extend their sympathy across the seas, and particularly those who have time and opportunity to visit Canada, will have an interest added to the daily round of life in this country, and at the same time will be doing the Empire a service by placing their professional knowledge in touch with Canada and in some degree helping to fill the vacancy indicated above.

The annual fee of membership is \$ 1-0-0 and fee for life membership \$ 10-0-0.

I shall be glad to forward the names of any persons wishing to join the Association to the Honorary Secretary in Ottawa.

LANSDOWNE. R. C MILWARD.

The Necessity for Fire Protection.

There seem to be a good many opinions in favour of abolishing fire protection in the Teak Forests of Burma, and some very good reasons are given. It probably has not been recognized by many outside Burma what *their* fires consist of;

for a jungle fire in these parts generally does assume proportions more like the American forest fire instead of being a creeping ground fire as Mr. Carter puts it. I have seen saplings in the Nallamalais of Kurnool, of which the age—counted by the rings on the stump left—was 10 to 12 years old, burnt to within a foot of the ground; and in the same locality I saw a Sterculia tree burn gradually down to the ground, beginning with its smaller branches from 30 to 40 feet off the ground. The sound of these fires can be heard for miles, and smuts from them are conveyed to Nandyal, 15 to 20 miles off. I presume that in such circumstances it could hardly be advocated that fire protection is unnecessary.

The fact of the matter is that there is a sort of idea prevailing that what is essential in one place must be essential in another; an attempt to fit the cork of a large bottle into a very small bottle, and *vice versa*. A great deal of money may possibly be wasted over fire protection in some localities when there is a crying need for funds for the same in other localities.

WALTAIR: A. W. LUSHINGTON.
7th August 1904.

A New Termite in India.

In the September number of the *Indian Forester* I have read an interesting note upon the subject of a new species of termite which, according to Mr. Radcliffe, was found by Mr. Wroughton in Kashmir last year and sent by the latter for identification to the well-known specialist in the group, M. Desneux. The latter very courteously honoured the sender of the specimens by naming the insect *wroughtoni*. May I enquire what Mr. Radcliffe intends to convey by his statement "M. Desneux had unwittingly named the species after Mr. Wroughton, but this *will now be altered !*" The italics are mine. May I ask what is Mr. Radcliffe's authority for calling the species '*radcliffei*?' A species once described and named is named for all time, provided the specific name attached to it has not been previously used for another species in the genus, and even if the describer were to change a name, already given by him to a species, scientists would pay no attention to the alteration unless there were very grave reasons for it. Without a hard and fast rule of this nature it would be impossible to work at all ; and I can only surmise that it is simply from ignorance that Mr. Radcliffe has acted in a manner which cannot but appear most discourteous to a distinguished foreigner and scientist.

In this particular instance your correspondent has not even the plea that he himself discovered and took the specimens sent to M. Desneux. What does he say ? On his own showing it was only that he told Mr. Wroughton where to find the insect or an insect like it. A very different thing ! He further states

that he sent some identical specimens to the Editor of the *Indian Forester*, several years ago. Since neither Mr. Radcliffe nor the Editor were, I believe, specialists in the group, it is not possible to make such a statement. The termites he sent may have had a *similar appearance to Termopsis wroughtoni*, but no one laying claim to the most elementary scientific knowledge would consider that sufficient to entitle him to rank as the discoverer of the species. Does Mr. Radcliffe imagine that we know all the termites of Kashmir? It would be a pleasant thought!

I would like to encroach upon your *valuable space* and make one other observation. Your correspondent appears to be labouring under the delusion that if a new species of plant or animal is discovered by himself, it should *ipso facto* bear his name. This is a fallacy as erroneous as it is common. Many describers refuse, except in very exceptional circumstances, to name a species after either its collector, its forwarder, or anyone else. They, and many think quite rightly, prefer that its specific name should either describe some very prominent characteristic or denote *the locality from which it was taken.* Others would only commemorate in the particular group or family the names of men who have actually devoted themselves and their work to it.

Whatever course the actual describer of the species may think fit to take, it should be borne in mind that he is conveying a favour, a very great favour, upon the discoverer of a new species by placing at the latter's disposal his special knowledge—a knowledge only acquired, probably, as the result of a life's work. Such being the case, criticism of his work can scarcely be deemed courteous.

E. P. STEBBING.

III.—OFFICIAL PAPERS AND INTELLIGENCE.

Report on the Rubber of Rhynchodia Wallichii from Burma.

By Professor WYNDHAM R. DUNSTAN, M. A., F. R. S., Director.

This sample of rubber, Register No. 19779, prepared from *Rhynchodia Wallichii* in Shwegyin, Tenasserim, Burma, was forwarded to the Imperial Institute for chemical examination and commercial valuation by the Reporter on Economic Products and is referred to in Letters No. 2721-32 F. S., of the 26th August 1903, and No. 154-32 F. S., of the 18th January 1904.

Several notices have recently appeared regarding the rubber-yielding properties of this plant, which is reported to be fairly common in the Pegu Division, and the rubber obtained from it has been described as of good quality.

The sample received for examination consisted of an irregular cake, weighing 48 grams, which was slightly mouldy on the surface The rubber was dark brown throughout and contained a small amount of vegetable matter. Its physical properties were very satisfactory, it being quite free from stickiness and exhibiting good elasticity and tenacity.

The rubber had the following composition:—

	Sample as received, per cent.	Calculated for dry material, per cent.
Moisture	2·8	...
Caoutchouc	86·5	89·0
Resin	6·5	6·7
Dirt	4·2	4·3
Ash included in dirt ...	0·48	0·51

These results show that this specimen of the rubber of *Rhynchodia Wallichii* is of good quality, as the dry material contains 89 per cent of true caoutchouc and only 6·7 per cent of resin. It may be noted that a small amount, about 1·5 per cent, of the caoutchouc was insoluble in the usual solvents.

The rubber was submitted to brokers for commercial valuation, and they report that at the present time consignments of similar quality would sell readily in the London market at about 3s. 6d. per lb. This valuation, it must be noted, is based upon the high prices which are at present ruling in the rubber market, Para rubber being 4s. 8d. per lb. on the day upon which the valuation was obtained, so that the price mentioned will represent rather more than the normal value of the rubber. There is no doubt, however, that the rubber of *Rhynchodia Wallichii*, if of similar quality to the present sample, would always sell readily and command a good price in the market. The plant is reported to be common in certain districts of Burma, and it therefore appears to be worthy of attention as a possible source of rubber.

WYNDHAM R. DUNSTAN.

IMPERIAL INSTITUTE, LONDON.
20th May 1904.

Lindera Aromatica, Brandis.

Extract from Letter, dated the 31st March 1904, from Sir D. Brandis to F. B. Manson, Esq., *Conservator of Forests*, Tenasserim Circle.

* * * * *

I also send a note regarding a most remarkable shrub, not uncommon in Martaban and Tenasserim, so aromatic that the dried fruit and possibly also the leaves may have a future commercially.

Perhaps you could get copies and translations made of this note for circulation among your officers in order to enable them to collect specimens, in the first instance to make sure that they have the right species.

(True Extract.)

Karaway, Burmese; *Laion*, Karen, an exceedingly aromatic shrub, the fruit of exceedingly pleasant taste. The fruit is sold. I found it first early in 1859 on the Taipo mountain, south-east of Toungoo, at about 4,000 feet. In April of the same year I found it in fruit on the D'onat range between Thaungyin and Haundraw, and have a full description of it written at the time in my notes. I found it a third time in February 1880, on the hills East of Toungoo at an elevation of 2,000 feet. At that time it was covered with white flower-heads. The leaves are lanceolate, the blade 2—3, the petiole slender $\frac{3}{4}$ inch long. Male and female flowers are on different bushes. The male flower-heads, on slender stalks $\frac{1}{2}$ inch long, are about $\frac{1}{2}$ inch in diameter, and each head contains 5 small flowers, enclosed in bud, by large involucral bracts.

This shrub is very similar to Lindera assamica, *Kurz*, sent to me by Mr. Smales from Upper Burma, and to Lindera citriodora, *Hemsley*, an exceedingly fragrant shurb of Japan, Formosa and China, and should, with a few others, be placed in a separate genus, the anthers of which are in some species 4-celled, in others 2-celled. It has been suggested to me that the leaves and the fruit of *Lindera aromatica* might possibly be of great value in the Perfumery trade; hence a supply of the dried fruit and of the leaves might be useful. First, however, it would be necessary to make sure of the species; specimens, therefore, in flower and fruit should be sent to me in the first instance. The following are the three closely allied genera of *Lauraceæ*:—

1. Litsæa, Anthers 4-celled.
2. Lindera, Do. 2-celled.
3. New genus anthers 4-celled, L. Aromatica Fl. with the leaves, L. citriodora Fl. when shrub is leafless.*

Anthers 2-celled L. Assamica Fl. 10—15 in each head.

KEW, *March 1904*. D. BRANDIS.

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* Fl. 5 in each head.

V.—SHIKAR AND TRAVEL.

The Distribution of the Hog-deer (Cervus porcinus).

In the article by Mr. Stebbing, on Captain Forsyth and the Highlands of Central India, attention is drawn to the alleged fact, that Captain Forsyth found the hog-deer in the eastern parts of the Central Provinces. Some doubt still exists as to whether this animal is found in the Central Provinces or not, and it would be interesting, both to scientists and to sportsmen, if the distribution of this deer were settled once for all. The latest authorities on the subject (Blandford and Lydekker) consider that the occurrence of this deer in the Central Provinces requires confirmation, and it would seem that the possibility of its occurrence in the Central Provinces has been based on Captain Forsyth's assertion alone. It is probable, however, that he was mistaken, or possibly the deer may have been exterminated since, although this is extremely unlikely. It has always struck me as curious that this deer did not occur in the grass lands of the Central Province sal forests; nevertheless I have not only never seen anything like it, but have never met anyone who has.

If any officers who have had experience of the Bilaspur, Raipur and Sambalpur districts would give their opinions on the matter, this question could be definitely settled.

'SOLID LEAD.'

A New Disease in Coorg.

An epidemic, which has caused many deaths amongst wild elephants, bison, sambur, spotted deer and cattle, has been prevalent not only in South Coorg, but in the adjoining Mysore and Malabar forests. So far no one has been able to say what the disease is, it being very infectious and fatal. The main symptoms are fever and developed buboes, and the animals attacked die within a very short time after the first appearance of illness. This disease is reported to have been observed in Wynaad (Malabar) in May last. It spread to South Coorg in June and last month to Tarikere taluq, Kadur district, Mysore State, where seven head of Amrut Mahal cattle are reported to have died with the symptoms described above. As far as I have been able to ascertain wild elephants have not been known to have been subject to any epidemic in the past, at any rate in this part of India. It would be interesting to know what the disease is, and if it has been observed in other parts of India or Burma.

SOUTH COORG:
14th August 1904.

A. M. MASCARENHAS,
Extra Assistant Conservator of Forests.

VI.—EXTRACTS, NOTES AND QUERIES.

The Forest Academy of Tharandt.*

BY G. CADELL, late Indian Forest Department.

THE CROWN FORESTS OF SAXONY.

Before entering more immediately upon the subject of this paper it is advisable to consider what interests are involved in the healthy activity of this Academy; for it is the pivot on which turns the judicious administration of the forest wealth of a kingdom in which rather more than one acre out of every four is underwood, yielding a direct return of vital importance, and contributing in no small degree to the general prosperity. The Crown Forests of Saxony are stated, on competent authority, to produce a net revenue of over 22s. per acre per annum, and at the same time to be in a highly prosperous condition as regards their permanent or capital value. To make a proper comparison of this return with that derived from agricultural lands, two all-important facts must not be lost sight of.

1*st.*—This revenue is obtained without any cost of exhaustion of the soil, and therefore without any necessity for its subsequent regeneration by chemical or other manures; and

2*nd.*—The capital, which in Forestry means the cubical contents of the timber crop, is yearly being added to by natural growth, and is consequently each year becoming more valuable.

And if we carry the comparison nearer home, there is yet another fact which makes the case for British Forestry still stronger, and that is, that in spite of our large imports from abroad, the price of timber in Great Britain is very much higher (perhaps it would not be unfair to say twice as much) than the prices obtained for similar wood in Germany. That these prices will show a tendency to rise and not to diminish in the future is a matter of common and reasonable expectation. So that it is possible, without undue exaggeration, to affirm that a revenue, largely exceeding what is above stated as now realised in Saxony, might be looked for from similar woods, when worked up to a similar standard of productiveness in Great Britain.

The employment given to the rural population by the tending and collection of the Forest revenue is an important factor common to both countries. What is more germane to our present subject is the part played by a fully-equipped Forest Academy in the building up and maintenance of the Forest capital.

THE FOREST ACADEMY.

The Forest Academy of Tharandt, with which is inseparably connected the name of Baron Cotta, whose memory is kept alive by the eighty oak trees planted round his grave in the grounds

* From Notes of the Surveyors Institution.

by his former pupils, is about eight to nine miles distant from Dresden. For such a purpose its situation is most favourable. Upon this three closely-wooded valleys converge, with a considerable stream, affording all the facilities necessary for the carriage of the wood by water, and its conversion by saw mills. It possesses within its walls not only class-rooms, but large collections illustrative of the sciences principally taught, such as chemistry, zoology, botany, and general fruit products, the collection of forest seeds claiming to be the largest in Europe. Outside, there is a forest garden or nursery which will demand below more especial notice, and its domain includes a large area of forests both pure and mixed, which with outlying "Lehrrivieres" or instruction woods, are under its sole management. It thus, besides being in itself an "imperium in imperio," forms a serious and valued branch of the State administration, and as such is placed under the Ministry of Finance. With a high prestige to be maintained, and with resources fully adequate to this maintenance, professors and students meet, with success in their studies already half achieved at the commencement. The prosecution of these is here a matter more of personal observation than of laborious committal to memory of hard axioms, involving often impossible, or at any rate unintelligible, conclusions. The science of Forestry is indeed present, but it shares with the practice the education of the Forester. How they go hand in hand towards the common object will be seen by the nature of the subjects taken up in the course of instruction.

THE COURSE OF STUDY.

This course extends over two and a half years (five half-years) beginning in October. In the winter session visits are paid under expert guidance to the various manufactories in the district, and in the summer there are botanical and zoological excursions, besides periodical inspections of the works under progress in the rivieres. The more strictly class-room course is divided into—

I.—Grund wissenschaften, literally "Ground Sciences," the fuller meaning of which is elucidated by the following list:—

(*a*) Natural Sciences, including Organic and Inorganic Chemistry, Mineralogy, Geology, Knowledge of Soils, Botany (including the Anatomy and Physiology of plants, fungi, and general forest flora), Zoology (or the study of the Vertebrates and Insects), Experimental Physics and Meteorology;

(*b*) Mathematics, including Surveys and Plan-drawing, keeping of Accounts and Road-making.

II.—Fach wissenschaften, literally "Professional Sciences," under which are placed—

Forest Science generally, Forest Law, Forest Construction, Forest Protection, Forest Use (including the measurement of woodcrops and of timber), Forest Finance, Forest Regulation, Forest Administration, and Forest Policy.

III.—Hilf wissenschaften, literally "Auxiliary Sciences," which are considered to be,—Legal Knowledge, the Management of Land, and the various matters pertaining to hunting, shooting, fishing, &c.

These, it will be observed, are all subjects rather of the field than of the study, and where they are prosecuted indoors it is only with the view of their practical application outside.

The Forest Nursery.

For such practical application the ground covered by the forest nursery, extending to 12 hectares (30 acres) gives ample scope. The specimen trees and plants are here arranged botanically, that is, according to their orders, the broad-leaved trees coming first and the needle-leaved trees occupying the higher ground. Thus all the trees of the "Quercus" tribe are marshalled together, so also with the "Abies" (Silver Fir), "Tanne" in German, the Picea (Spruce), "Fichte" in German, &c. The Pinus Sylvestris (Kiefer), of which the German variety differs slightly in the colour of its wood from that raised in Great Britain, is specially prized and bears an excellent timber. The merits of the "Douglas," too, are fully recognised. Here, too, are specimens of trees which grow suspended in tubs containing only water, without any direct contact with the soil. These are nourished with "feeds" of chemical manures, the object being to illustrate to what a large extent trees, and indeed all plants, are dependent upon the atmosphere which they breathe for their life and growth. The most unhappy "subjects" at the date of my visit appeared to be the Himalayan "Silvers," Webbiana, &c., which have not as yet taken very kindly to their altered conditions of existence. As showing the universality of the interest taken in the collection, I may mention that I met, purely by accident, the Chief of the Bulgarian Forest Department, a former confrère at Paris in 1900, and an official of the Forest service in Java. The Director of the Academy (Dr. Neumeister) is *ex-officio* Keeper of the Royal Garden; and in it he has, if I may so call it, a most useful colleague. The natural "habitat" of trees, for example, has most intimately to be considered in their importation and acclimatisation. To take a similar instance, the cedar grown on Mount Lebanon bears a different quality of wood, and is in all respects a different tree from the cedar on a Surrey lawn; and for anyone who seeks to find in forestry the outcome of a successful financial enterprise, the knowledge of the altered conditions imposed by altered circumstances is most necessary. It is possible to predicate a fairly certain proposition regarding an indigenous tree; regarding an exotic it is not.

The Forest Library.

The extensive and valuable Forest library within the Academy building supplies to the student all information regarding trees

in their native habitats. In it and in the Herbarium he has the means of identifying and comparing the various subjects of his out-door examination. The books are also lent to outsiders accredited to the Director or otherwise vouched for. There is no space here for even a cursory enumeration of the books and manuscripts themselves, and I gladly avail myself of the excuse; for the feebleness of British Forestry is painfully exemplified by the small number of books in English, while other nationalities are fully represented. In Forest booklore, Germany is naturally facile princeps.

Fees payable at the Academy.

Passing on to the cost of the education given at the Forest Academy, we shall find that, looking to the advantages for study, *as given above, the fees payable are very moderate. They amount* to only 225 marks per annum, payable half-yearly, together with a half-yearly subscription to the hospital of 15 marks additional; the whole cost may thus be placed at something under £ 12 a year for instruction. Board and lodging can be obtained in the village—for this is not a resident college—at the rate of 12,000 marks or £60 per annum; but of course the student is not in residence during the whole year. The cost of obtaining a certificate of proficiency in forestry, which can be secured by the diligent student within the two-and-a-half years' course, can thus be easily calculated. Less easy of calculation is the value of that certificate after it has been obtained, and the prospects of employment which it holds out.

It may here be noted that the openings in Saxony for such employment are very limited.

The proportion of wood in the country being so great, as above stated, every Saxon landowner is himself a forester, and he knows how to manage his woods, which, it must be remembered, have been handed down to him in a strict course of regulation, with the view not only of direct returns, but of their indirect value to his arable or pasture lands. The majority of the students at the Academy of Tharandt are therefore foreigners, who hope to find the market value of their forestal knowledge in their own or other countries. A countryman of our own, for example, has come over from New Zealand to study Forestry at Tharandt, with the view of applying his knowledge on his own land on his return to the Colony. The value of this Academy lies in the fact that no young Institution can hope to rival, in the immediate future, advantages which it offers. These have been the growth, under successive Directors, of well-nigh a century. A Forest Academy, like a Forest itself, requires time for its development and instructive usefulness. There are, further, several scholarships attached to the Academy, for the encouragement of successful students.

THE TEACHING STAFF.

The success of all colleges and academies depends, in no small degree, not only upon the professional knowledge, but upon the personality of the members of the teaching staff. In such an academy as that of Tharandt, where there is such a variety for pursuits, and where professors and students are necessarily thrown into such intimate relations as these entail, there must be a community of tastes and sympathy in their prosecution. The discipline of the lecture room is relaxed in the practical work of pisciculture, for example, or in the chase. During the course of the daily excursions or the more extended tours taken in summer, circumstances arise when the resourcefulness of the student comes to the assistance of the knowledge of the professor.

Within doors also, the free interchange of thought is encouraged by the monthly discussions, or debates, which relieve the daily lectures. In such debates, which form part of the statutory course, the professor speaks no longer *ex catchedra*, but from a common platform with his students. Besides the Director, who himself delivers lectures, chiefly on Forest trees, there are two professors of Forestry. There are four professors of natural sciences, the scope of which has already been explained. Two professors for mathematics, and one for land surveying complete the teaching staff. The status of each of these is strictly defined, and his obligations to the State on the one hand and to his pupil on the other clearly indicated. Besides delivering lectures they have the custody of, and are required to keep up to date, the collections and museums illustrative of the subjects which are their peculiar charge. They attend also the sittings of the Law Courts when these are held at Tharandt and discuss with the students the arguments which are advanced on either side in the conduct of the cases. There is but little of the stereotyped pedagogue in the Tharandt professor.

THE STUDENTS.

If the obligations of the professors to the students are thus clearly defined, so also are the obligations of the students to the professors. Many of the students are foreigners, for forestry at the teaching stage, as at all others, is independent of nationality. It is only required of those that they shall be able to follow the lectures, which are given, of course, in the vernacular. From all a certain standard of general knowledge is exacted before admission, and where the prospective pupils are minors, the written consent of their parents or guardians must first be obtained. In addition to the regularly enrolled students, outsiders may attend the lectures or join in the excursions, at the discretion of the Director. It is not necessary to give *in extenso* the regulations imposed upon the students for their general conduct.

That these should exist in written form is no doubt a necessity of the case, but when a young man reaches the age at which he may become a forestry student, written rules will not keep him straight if he chooses to run otherwise. For such there is no *room at the Academy. There can be no advantage either to* professor or to student in a course which ends in the finding "ungenügend," unsatisfactory=0 and a certificate marked "kaum genügend," fairly satisfactory=1 will be but of little assistance to its professor in his after-search for employment as a Forester. Good conduct and attention to discipline may therefore be confidently looked for in the forestry student at Tharandt.

The village, although boasting the usual Kurbad and mineral waters, has nothing in itself to distract the student. A ready market is found for all cut timber, and in the neighbouring small town of Rabenau there is a large manufactory of chairs, in which, as in Buckinghamshire, beechwood, which is here a natural product of the soil, is greatly used.

Challenge to Great Britain.

In the nature of things, the existence of such a college as that of Tharandt is not possible in Great Britain in the immediate future, however ardently it might be desired. There is, however, no great evidence of this desire, if one may judge from what are called the "forstgartens," which it is proposed to attach to some of our agricultural colleges. It is not easy to guess what the object of these playthings is intended to be. The whole subject of Forestry in Great Britain is approached as cautiously as if it were a stinging nettle, and like the nettle it will resent the feebleness of the grasp extended to it. The complaint, which is really more an excuse than a complaint, made by successive administrations "that Forestry does not receive sufficient support from private proprietors, the class which should be most directly interested," covers less than half the truth. It may be granted, indeed, that practically the whole of the afforested area of Great Britain is in the hands of the private proprietors, and that the so-called Crown Forests are insignificant in extent, and still more insignificant from the view of their value as timber-producing properties. It is true, therefore, that they hold the key of the position, but it is also true that they are prevented from making use of it. If they are expected to enter upon such a permanent improvement as that of forestry, which benefits not only themselves, but the country generally, they have a right to demand that the State shall lead the way in the *systematised management* of woods, and that their work shall not be undertaken haphazard and in the dark. And they have the right, too, to demand that during all the period of their unrecuperative outlay, say, roughly 23 to 25 years, the lands they are afforesting shall be free from all taxation, including death and succession duties. In no other country but our own are the hands of the private proprietors thus

doubly tied. Those who still make their woods pay their way in Great Britain do so only under the most judicious administration, and in spite of, rather than by the help of, the treatment they receive from the Government. The generality of proprietors have, under present conditions, no choice but to prefer the rents which they can easily and at once obtain from sporting, to the postponed returns they may expect from woods. And so long as they maintain upon their properties such a proportion—a proportion far below that which is held to be judicious in Saxony under timber so as to give shelter to their flocks and herds—they will give preference to woodlands for coverts, our full and close grown crops of timber. Without unduly appreciating the home policy of other countries, to the depreciation of that pursued in our own, it is yet permissible to say that a clear challenge to take up the case of what is confessedly a neglected science in Great Britain comes from the Forest Academy of Tharandt.

The Timber Resources of European Russia.

Of so much of the vast Empire of Russia as lies within the geographical confines of the continent of Europe, no less than 510,300,000 acres are forest land. The very magnitude of these figures hides their significance, and they become more intelligible if we say that they give an area of nearly five acres for every inhabitant. Of this great woodland area the State is the largest owner, possessing, after the exclusion of waste, no less than 234,900,000 acres. (We are dealing with the figures in respect of Russia in Europe alone.) Private individuals own 108,000,000 acres, and peasant communities 43,200,000 while 14,800,000 acres are under the administration of the Appanage Ministry. From its forests the Government derives a revenue of about seven millions per annum. The important share which the wood trade takes in the foreign commerce of European Russia may be gauged from the fact that the timber exported represents about 9 per cent. of the total exports.

So large a share of the national wealth is represented by forests that regulations for their protection were obviously required, and accordingly we find that so far back as the days of Peter the Great the wood-bearing areas of Russia have been subject to protective ordinances. By these laws the rights of private owners were originally considerably restricted, but in the reign of Catherine II were amended in a more liberal sense, since which it has been found necessary to place all forests, whether owned by the State or by private individuals, in certain matters under the control of the central authorities. The important place which forestry occupies among the administrative departments of the country may be gathered from the fact gleaned from a

recent Government publication from which other particulars here mentioned have also been obtained—that the staff of the "Liesno Department" in St. Petersburg and the provinces numbers more than 3,000 individuals.

One of the main objects of the forestry laws of Russia is the protection and creation of forests serving purposes of general public utility, such as consolidating shifting sands, protecting land from erosion by water, &c., or in the neighbourhood of sources of rivers and, therefore, contributing to the regular supply of water. Such forests are termed "protective," and may not be disafforested. In considering the forest resources of Russia in reference to export capabilities, allowance must, of course, be made in respect of these "protective" areas; but, unfortunately, no figures appear to be available. Another important feature of the law is the creation in each government of a committee having for its object the conservation of forests. The composition of this committee is of a mixed character, comprising both officials and forest owners. It is the duty of the committee to decide what forests are to be declared "protective," to put a stop to reckless or wasteful felling, to approve or modify plans of management which have been submitted by private owners, to exercise general supervision over all the forests of the district, and to institute legal proceedings against persons infringing the forest laws.

It should be noted that owners of forests desiring to make clearings in forest land must announce their intention to the committee, and if in six months no refusal has been received permission may be taken for granted, and the owner may begin cutting. Owners of forests not declared "protective" may draw up plans of management in accordance with certain regulations laid down, and if the plans are sanctioned the owner is not subject in the development of his timber to any other restrictions than those designated and sanctioned in his plan of management. The regulations provide that cycles of felling shall be for plantations of conifers not less than 40 years. In plantations of conifers with fir trees predominating, if among the latter there are not less than a thirtieth reproductive more or less regularly distributed over the area for cutting, the breadth of the annual felling is decided by the owner.—*Timber Trades Journal.*

A Student of Forestry.

The *Times of India*.—We are glad to record the return to India of Dr. Noshirvan Gustasp, an energetic and enterprising member of a Parsee family of Surat, who for some years past has been studying forestry in Europe. Dr. Gustasp appears to have an unusual bent for forest work, and in the course of an extremely creditable career has triumphed over many difficulties. He first studied at the Imperial Forest School at Dehra Dun, where after a two years' course he obtained a Forest Ranger's certificate. He then proceeded to Europe, and applied for leave to enter Cooper's Hill, but to his chagrin found that he was two months over the age-limit of twenty years. Full of disappointment, he returned to India, where he accidentally heard of the great forest schools of Germany. With commendable perseverance he went at once to Germany, spent six months in unremitting study of the German language, and then entered the Forest School at Tharandt, in Saxony. Two years later he passed the examination in forestry at that Institution. Afterwards he went to Giessen, the headquarters of the Forest School attached to the University of Hesse Darmstadt. There he studied for nearly four years more under some of the ablest of German forest experts, including Hess, Wimmenauer, Thaer, Albert, Hansen, and Sievers. Finally, early in the present year, he took his degree of Ph. D. at Giessen, his thesis being "On the Use of Underground Wood." Dr. Gustasp has now, on the completion of his training—which was watched with great interest by Sir Dietrich Brandis and other experts in Indian forestry—resumed residence in India. His great ambition is to find employment in the profession of his choice in his native Presidency. We trust that so admirable an example of perseverance in the face of many obstacles will be adequately recognised by Government, and that Dr. Gustasp will be accorded that opportunity of following his profession which his exceptional

training and his commendable enterprise render him worthy to receive. Such persistent endeavours on the part of a native of India, to qualify himself without any external assistance for a scientific calling demanding special knowledge, deserve warm encouragement.

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Notice to Contributors.

MR. E. P. STEBBING on his return from leave has resumed the Honorary Editorship of the *Indian Forester*, and all contributions should now be addressed to him at Dehra Dun, United Provinces.

Pioneers of Indian Forestry.

CAPT. FORSYTH AND THE HIGHLANDS OF CENTRAL INDIA.

BY E. P. STEBBING.

It has been already pointed out that at the time the Central Provinces were constituted little was accurately known regarding the forest resources of their waste regions. It had indeed been suspected that the projectors of the railways had over-calculated the possible supply; but it was not guessed that the exhaustion had gone so far as really proved to be the case. The pernicious system of cultivation (*dhya*-cultivation or *jhuming*) of the hill tribes was in itself almost sufficient to have proved the ruin of the forests, but other causes had also helped. The most valuable timbers for railway and other purposes were the teak and sal, no other having at that time been found to be really lasting when subjected to the great and sudden variations of the Indian climate. The teak was perhaps the most generally useful, and on it, where found, had fallen the weight of the people's requirements; and it is probably due solely to its valuable coppicing capabilities that it had survived at all in many areas. The coppice shoots grow in the course of a few years into large poles, and these formed the chief demand of villagers for the construction of the small houses in use in this part of India.

To this fact may perhaps be explained a moiety of the apathy with which native governments witnessed the wholesale destruction of their valuable forests to fill the pockets of the few. There was, however, at the time of the formation of the Central Provinces Administration a good deal still left in the remoter forests, where communications were not so easy; and the forests, if properly taken in hand, might have yielded a steady supply of large timber for many years. The fatal mistake was,

however, made of announcing that, *after a certain time,* the forests would be brought under Government management and strictly conserved. This was the death-blow to the remainder of the teak throughout the northern parts of the tract.

To any official with a few years' experience of district work it is hardly necessary to state the all too obvious result of this brilliant administrative order, surely the first Secretariat effort of a newly-joined griffin! The railway contractors, and numerous speculators, foreseeing the value timber was likely to acquire, owing to railway operations and the closing of the forests, went into the jungles with bags of rupees in their hands and spread them broadcast among the wild tribes with instructions to fell, fell, fell and spare not! One can picture the joy of those *junglis* and their astonishment at the permission, or rather order, given to them to go into the forest and carry on one of their favourite pursuits unchecked, *i.e.*, the indiscriminate cutting of fine trees. Who does not know their methods?—the careful selection of some giant of the forest, the careful training of it so that in its fall it may bring down as many neighbouring trees as possible and commit the maximum of destruction in the forest with the minimum of trouble to themselves. This prompt action on the part of the timber fraternity resulted in every teak tree larger than a sapling being laid low and marked with the contractor's own mark, and scarcely anything accessible escaped the axe. Such was the legacy left to the newly-formed Forest Department in this region, and surely no more onerous charge, none fraught with more exacting conditions and bitterer consequences, has ever had to be taken up. Simple is the destruction of a forest, but fraught with much difficulty is its reconstruction.

Following upon these wholesale felling operations came delay in the railway works, resulting in the failure of the contractors and want of money. The cut timber was abandoned wholesale where it lay. Teak wood is full of oil, and in the ensuing fire season large numbers of logs were burnt where they lay—a total loss. The exact amount of destruction will never be known. Forsyth states that for years afterwards when exploring the forests they continued to come upon the charred remains of these teak trees, numbers being quite immature and unfit for felling. All that were worth anything were saved by the Department in after years, and the value, even of these, amounted to many lakhs of rupees. They were not, however, a hundredth part of those that were cut, the number of which should probably be reckoned by millions rather than thousands. It is still most doubtful whether the injury done to the forest and to the country by this most mistaken measure will ever be fully recovered; and it certainly furnishes a most valuable object-lesson to such of our Colonies, and to America, where acts of a similar nature are still being carried out. The history of the last thirty

years' work of the Central Provinces Forest Administration in these areas should prove instructive reading for them, and would well repay the study. *Verb. sap.* Such was one of the most material results of the utter ignorance of the administrative officers of that period regarding everything connected with the wilder portions of their charge. The mischief had been completed, and most of the timber speculators had bolted from their creditors, leaving their logs smoking in the forests, before the formation of the Central Provinces Administration and ere the Forest Department had entered on its work of exploring and arranging for the protection of what was still worth looking after.

That the same fate did not overtake the Sal forests was due chiefly to the preference exhibited for the teak, to the greater difficulty in felling the sal tree, and chiefly to its greater inaccessibility from the populous regions, the nearest point at which any great supply could be had for the railway being about a hundred miles by a bad land route. Forsyth stated that up to 1870 this had proved an insurmountable obstacle to the general utilisation of this timber on railway works. We perhaps should not be inclined to agree with his statement that the supply is inexhaustible, for the inevitable contractor has practically cleared all sizable (and many unsizable) trees from most of the Central India Native States since his day, and the Government forests in parts have been considerably worked. Our Pioneer's note on communications reads like an extract from a present-day Annual Report, or review on such. We read "a stronger commentary on the commercial value of easy communications could not be found than this, that the railways have found it cheaper to import pine sleepers from Norway, and iron-wood from Australia, than to carry the sal timber growing within a hundred miles of their line. There is something wrong where this is the case, and that something is the want of a good road into the sal regions from the railway at Jubbulpore, which road should have been made, for many other reasons besides this, long ago." This was in the sixties. Forsyth did not here mean that the Forest Department was responsible for the absence of the road or that it should be made by them. Thirty years later, in the nineties, had Forsyth toured round India he would have found many similar cases. The Bengal-Nagpur line running through the Chota Nagpur Government sal areas is sleepered with iron pot sleepers, the E. I. Railway is sleepered with sal it is true, but, until within the last few years, sal chiefly from Native States cut *à la* Central Provinces teak model of the sixties; the Assam-Bengal sleepered in many parts with pyinkadu from Arakhan on the same principle the reason usually having been due to want of adequate provincial communications. Since those days it has, we think, become recognised that the building and up keep of the main roads of a district, even where they run through great forest regions, does not fall within the province

of this Department, the latter being solely responsible for the feeder roads, tramways, etc., which will enable it to get out its produce on to the main arteries of the district. In the absence of the latter it becomes very difficult for the Local Forest Officials to compete with imported foreign timber.

Forsyth was to commence his work in the Pachmarhi hills, the lofty block crowning the Satpura Range to the south of the Narbada River. Here the centre of the operations in this extensive forest region was fixed, and a permanent forest rest-house at what is now the headquarter station of Pachmarhi was to be built in the heart of the country of the Gonds and Korkus, whose interests were, if possible, to be united with those of the newly-constituted department in the preservation of the remnants of the fine forests which had once clothed the slopes of their hills. As has been said, this rough country was little known, and its exploration meant hard work and constant exposure—the only abode a small pal tent. Those were not the days of the 12-mile a day stage on a good road with a fine bungalow at each end, and yet to those who still consider that mud huts are all that are required in camp, it might be pointed out that the sudden termination of such a valuable life as that of Forsyth's, unavoidable perhaps in those days but none the less a severe loss to his Government, was due to what is nowadays unwarrantable and unnecessary exposure. It can scarcely be gainsaid that the value of a senior man's work must depend to a great extent on his health, and that in nine cases out of ten the state of the latter is directly dependent on the care taken of him in the days of his first service.

Writing of the pleasures of camping in a good open country in the cold weather, Forsyth says "Very little of this sort of thing fell in the way of Forest Officers of those days however. Our work lay in the depths of distant forests, or at most in the half reclaimed frontier belt lying between the hills and the plains, where timber transactions generally took place and the chief depôts for forest produce had been established. When by chance our direct route from forest to forest led across an open region our movements were as rapid as man and beasts could make them, and at the earliest possible moment we hurried again from the face of civilisation, like ghosts at cock-crow, to bury ourselves again in the depths of the wilderness." In after years Forsyth saw the reverse of the picture, when acting as Settlement Officer of Nimar. Speaking of the forests then, he said that he was able to look upon the forest-covered hills on the blue horizon as an agreeable vanishing point in the landscape, or as unpleasantly complicating the questions of liquor excise and police administration! It is amazing, he says, what a difference the point of view makes. After having been both Forest Officer and Settlement Officer with a large district, he wrote "The man who has dwelt for years amongst the forests, and their simple wild inhabitants, will regard nearly every question that arises in a wholly different light from

him whose experience has lain only among the cornfields of the plains, and their tame and settled tillers. And each of them will probably arrive at a conclusion as little comprehending the whole bearings of the question as the other." Such an opinion from as clever a man as Forsyth, who had served in both fields, is well worthy of remembrance.

To reach the Pachmarhi Hills Forsyth marched up the Narbadda Valley, and his remarks on that picturesque country show him to have been an ardent lover of Nature, in whose school he had trained his powers of observation to a very high pitch. When to this may be added a versatile pen and a rare power of expressing his thoughts one can gather what an interesting companion the man must have ever proved himself. Writing of a well-known scene of remarkable beauty, he says "What visitor to Jubbulpore can ever forget the Marble Rocks! In any country a mighty river pent up into a third of its width and for a space of two miles *or more* boiling along, deep and sullen, between two sheer walls of pure white marble a hundred feet in height, must form a scene of rare loveliness. But in a bustling (*sic*) dusty Oriental land, the charm of coolness and quiet belonging to these pure cold rocks and deep and blue and yet pellucid waters, is almost entrancing. The eye never wearies of the infinite variety of effect produced by the broken and reflected sunlight, now glancing from a pinnacle of snow-white marble reared against the deep blue of the sky as from a point of silver touching here and there with bright lights the prominences of the middle heights and again losing itself in the soft bluish greys of their recesses. Still lower down, the bases of the cliffs are almost lost in a hazy shadow so that it is hard to tell at which point the rocks have melted into the water, from whose depths the same lights in reverse order are reflected as clear as above, but broken into a thousand quivering fragments in the swirl of the pool." The man who penned this was meant to do more in the world than teach thick-skulled recruits how to hold a rifle and the neceties of the goose step, with all its reoccuring monotony. As is well known, the Rocks are guarded by swarms of the large bee (*Apis dorsata*), and many grievous accidents have resulted from meddling with their colonies. Forsyth says that the only resource if attacked by this insect is to rush into the nearest thick bush, break off a leafy branch and lay about with it wherever there is an opening. A native shikari of the writer's showed him another way. We were out shooting in April and were suddenly attacked by the bees. An incontinent stampede down the road, which we were luckily on, was the immediate result. A mile and a half ahead the forest suddenly ended, and the open country was reached, but it was not until we had left the forest line about a quarter of a mile behind that the last of our aggressors left us, numerous bad stings being the result of the attack. The bald head of my companion looked as if it was under the influence of some powerful hair restorer, for it

had suddenly regained a covering of stout stumpy hog bristles!" Whilst we were engaged in woefully picking out the stings, aided by the assistant shikaris, the headman came up quite untouched and smiling. He explained that on the first onslaught of the bees he had followed us for a few yards, and then quietly stepped off the road and slipped behind a neighbouring sal tree. The bees, blind and mad with rage, followed the retreating enemy, and he was left in peace. The method requires a strong nerve and implicit faith in its effectiveness when one sees one's companions doing time in the distance, but he who is provided with both will find it the best protection in the case of an ordinary attack in the forest; for such will usually be from the representatives of but a few colonies of combs. It is only in the hotter parts of India that this bee is to be feared, and then chiefly from March to July. So desperate is their onslaught that it is said that during the Mutiny a large force of troops, horse and foot, were ignominiously routed in the neighbourhood of Lucknow by these terrible insects. As is commonly known, the honey and wax are exported and form a source of forest revenue in parts of the country. The habit of the bees in building high up on the branches of trees has, in the days of yore, been the death-blow of many a forest giant, for the wild *jungli* did not hesitate to fell a mighty sal tree for the sake of securing a single comb attached to a branch far up in the spreading crown; the value of the wax and honey obtained being a rupee or two, that of the tree destroyed and wasted several hundred. And yet there are some people still who wonder what the Forest Department was formed for!

Forsyth has some interesting observations upon the beautiful Narbada Valley as he found it in the sixties. It had formerly been the happy hunting ground of the Gonds and other wild tribes, who are now chiefly confined to the hills which surround it. In those days it could at most have been but scantily patched by their rude tillage, before the arrival of the Hindu races, who had cleared its forests, driven the wild elephant that roamed through them to the far east, and covered its black soil with an unbroken stretch of fine wheat cultivation. In less than three centuries this has come about, and yet it is often said that India is standing still in the history of the Nations! Everything proves that this country is a country still in its youth. The people strong limbed and healthy, an energetic race tilling an almost virgin soil, tilling it roughly still it is true, but, as Forsyth remarks, "the example of all new countries with much available land, even when, as in America, all the resources of capital and machinery are available, shows that a comparative rough culture of a large area is more remunerative than the higher tillage of a smaller area; and this alone is the cause of the rude state of agriculture still observed in this and many other parts of India."

Ethnologically the Hindu races of this tract are of great interest. They have generally been comprehended in the cate-

gory of "Aryan" as distinguished from the "Tauranian" peoples who are believed to have preceded the fair-complexioned Aryan invaders from Upper Asia in the occupation of Hindustan, and among them are included the remnants of wild tribes still found in the hills. These Hindu races have, however, themselves been subjected to some influence which has greatly modified the original high Aryan type—a type which includes the noblest races of mankind; the Caucasian of Europe, the Persian of High Asia, and the Sanscrit-speaking fair-skinned people who entered India from the north uncalculated ages ago. This influence has not been one of climate alone, for this would have affected all their descendants equally; whereas the very greatest range of diversity is to be found, from the light-coloured noble-featured Brahman of the extreme north-west to the black and negro-like Chamar or Parriah of the east and south. Everything proves that there has been a mingling of the immigrant race with the inferior Tauranian tribes whom they found occupying the soil before them. Judging from the physical features, few but the highest castes of Northern India can have any claim to purity of Aryan blood, and the admixture of indigenous blood, as indicated by colour and feature, becomes greater and greater the further away one goes from the seat of the original Aryan settlements in the North-West. The modern Hindus therefore are a composite race in all probability resulting from the absorption of a wave of Aryanism in a great ocean of peoples of a far inferior type—the type in fact which is at present found represented by such of them as have still remained undiluted in their inaccessible hills. It is this type which is so well known to many an Indian Forest Officer, the man who has roamed the forest-clad hills in undisputed sway for centuries. It was this type to whom the march of civilization and progress sent up Forsyth and his companions to make the first efforts at inculcating the doctrine of the value of the forests of the homeland and the disasters that would follow inevitably in the train of their total destruction. Can one be surprised at the difficulties which confronted and awaited such a crusade, and is it not really marvellous what wonderful success the Forest Pioneers, backed up by an ever-watchful and enlightened Government, achieved? There were apparently retrograde steps, one thought them so in those days (each one of us likes to see his life's work successful in his own time, it is but human nature), but it was merely a case of *reculer pour mieux sauter*, and we, their successors, can now fully recognize the full value of each step taken, and can see that it was a case of the more haste the worse speed. We, their successors, have still to bear the same truths in mind if we have the real interests of our mission in the country at heart.

Our soldier Forest Officer had plenty of sport whilst marching through the open country *en route* to the hills, and he has interesting notes on the various animals he met with. Amongst

herbivorous animals he mentions the black buck (Antelope *cervicapra*), the chikara or Indian gazelle (*Gazella bennettii*) and the Nilgai (*Boselaphus tragocamelus*), all antelopes. The carnivorous animals found in the open were the hunting leopard (*Felis jubata*), the wolf (*C. pallipes*) and jackal (*C. aureus*), the tiger and panther being rather denizens of the low hills than of the plains. Some most interesting stories on the habits of wolves are given. These animals gave great trouble during the construction of the railway through the low jungles north of Jubbulpore, attacking, killing and eating the labourers, full grown women, and at times men. The attack was commonly made by couples, one of the wolves seizing the victim by the neck from behind, while the other, coming swiftly up, tore out the entrails in front. These confirmed man-eaters were said to be very wary and fully able to discriminate between a helpless victim and an armed man. Amongst the animals of the plains must of course be included the boar—almost unrideable however in the black soil of the plains, interspersed by yawning creeks and fissures, or amongst the rolling trap boulders, which is the other alternative. Plenty of work for the shot gun is obtainable in the cold season. Snipe and wild fowl begin to arrive in these central regions of India, travelling from the frozen wilds of Central Asia, early in October, and before the end of November every piece of water and swampy hollow affords its contingent of birds. The common teal (*Nettium crecca*) and the whistling teal (*Dendrocycna javanica*) are the most numerous, as well as the first to make their appearance. The lovely blue-winged teal (*Querquedula circia*) is scarcely less common; of larger ducks the red-headed pochards (*Netta rufina*), wigeon (*Mareca penelope*), pintail (*Dafila acuta*) gadwall (*Chaulelasmus streperus*) are found throughout the winter on most tanks. On the main rivers and on those large reservoirs such as Bhandara and Lachora in Nimar (the work of giants of ancient days, whose descendant appears to have made his appearance in the person of Sir W. Garstin in Egypt, if we are to believe recent reports) which may be called lakes, many other species of wild fowl are found, including the mallard (*Anas boscas*), common grey goose (*Anser ferus*) and black-backed goose (*Sarcidiornis melanotus*) the latter being very common. Amongst wading birds, storks, herons, and cranes haunt the pools and marshes, and are a source of continual interest to the naturalist. The Demoiselle crane or coolen (*Anthropoides virgo*) is delicious eating, and may be seen in flocks in the wheat and gram fields, but will be found to be very difficult to approach. On river banks will also be found the sarus crane (*Grus antigone*) and the Brahminy duck (*Casarca rutila*). The gray quail, by no means so common as in Northern India, and the gray partridge, which is very common, are to be seen in the fields. The latter feeds freely in the vicinity of villages, and Forsyth mentions having seen a covey of them run out of the carcase of a dead

camel! The list comes to an end with the beautiful and sporting painted partridge (*Francolinus pictus*), which here replaces the black partridge (*Ortygornis pondicerinus*) of Upper India.

Probably the most valuable tree of the plains to the villagers is the well-known mhowa (*Bassia latifolia*), the corolla of whose flower drops whole, and is eaten or used in the distillation of ardent spirits by the people, whilst the nuts, which form in bunches after the flowers have dropped, yield a thick oil much resembling tallow in appearance and properties.

Leaving the valley and plains we will now accompany Forsyth into the forests amongst the beautiful Mahadeo Hills.

(To be continued.)

A Contribution to the Forest Flora of the Jubbulpore Division, C. P.

BY R. S. HOLE, F. C. H., F. L. S., F. E. S.

In 1900 a list of the trees, shrubs and climbers occurring in the Jubbulpore forests was drawn up for incorporation in the Working Plan. The list then prepared contained some 130 species. The list now given below includes several additional trees, shrubs and climbers which are found in the forests of the Jubbulpore Forest Division, also a few trees, shrubs and climbers which are commonly cultivated in gardens or avenues, and, finally, a few herbaceous plants which are likely to be noticed by a Forest Officer on account of their coarse habit, showy flowers or economic importance.

The list is still very incomplete and, in a few instances, possibly inaccurate. I had hoped to be able to remedy this, and, also to add, among other things, details regarding the sylviculturally important characteristics of the principal species in this locality. An unexpected transfer has prevented this, at all events for the present, and the list is now given in the hope that it may be of some interest, even in its present very incomplete form. It may be mentioned here that two sets of experimental coppice plots were opened in this Division a few years ago, which should furnish valuable information regarding the coppicing capacity of some of the principal species and their relative rate of growth.

In the present list particular attention has been paid to the vernacular names both as regards their frequent verification and their correct spelling. In some cases, however, the names given are doubtful and require further verification. They have been given as they may serve as a guide to future observers. It is as well to note that among the illiterate natives with whom the

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Forest Officer principally comes in contact, the following letters appear to be freely interchangeable :—

n	and	*l*,	thus	*nalli* or *lalli*.
s	,,	*sh*,	,,	*asto* or *ashto*.
l	,,	*r*,	,,	*aunla* or *aunra*.
d	,,	*r*,	,,	*lendia* or *lenria*.
b	,,	*w*,	,,	*tilban* or *tilwan*.
ch	,,	*s*,	,,	*sita* phal or *chita* phal.

In Gondi, the word *mara*, which simply means *tree*, is usually added on to the name of the tree, thus *nalli mara*, etc.

Doubtful specimens have, through the kindness of the authorities at the Royal Botanic Gardens, been identified for me at Sibpur, and Rai Sahib Upendranath Kanjilal has also kindly done the same, in some cases, at the Herbarium of the Imperial Forest School, Dehra Dun.

The letters F. B. I. indicate the reference to Sir J. Hooker's *Flora of British India*, and a reference has also, when possible, been made to the *Forest Flora of N.-W. and Central India*, by Sir D. Brandis.

Before proceeding to the list itself a few remarks are given below to give a general idea of the locality here dealt with. In these remarks the numbers appended to the names of the various species are the serial numbers of the accompanying list.

The Jubbulpore Forest Division comprises all the Government Reserved Forests situated in the Jubbulpore Civil District of the Central Provinces, in addition to those of the Mandla District, which lie to the north-west of the Balai River. The area here considered, therefore, lies roughly between 22° 45′ and 24° N. Lat. and between 79°45′ and 81° E. Long.

We are here on the great watershed between the Ganges and the Narbada, the drainage of the centre and south of the area flowing into the Indian Ocean *via* the Narbada, while that of the north finds its way into the Bay of Bengal through the tributaries of the Jumna and Ganges. Jubbulpore, the junction of the E. I. and G. I. P. Railways, is roughly midway between Bombay and Calcutta (by rail 784 miles from Calcutta and 616 miles from Bombay), and the central position occupied by this district in Peninsular India adds to the importance of its flora, which is already sufficiently interesting to the Forest Officer, owing to the fact that here the *teak* (258) and *sal* (14) forests meet.

The south of the area consists of a confused mass of trap hills, lying to the south and east of Jubbulpore town, on which are situated the forests of the Bargi, Dhanwahi and Jubbulpore Ranges, these including the principal teak forests of the Division. To the north of the trap, and running north-east and south-west, stretches the long narrow plain which occupies the greater portion of the Jubbulpore district. The northern part of this plain drains into the Ganges and the southern into the Narbada, the Bhureegurh Range of Bijawar rocks forming the watershed

between them. In the south, this plain is covered by a rich deposit of black cotton-soil, while in the north, low lateritic hills occupy a considerable area. The plain is bounded on the west and north by the Vindhyan Hills and on the south-east by a ridge of trap rocks running along the bank of the Mahanadi, this ridge being a projection of the mass of trap hills covering the south of the area.

In the north-east the plain continues in a tract of open country, occupied chiefly by the upper Gondwana beds of sandstone, clay and shale, on which are situated the most important *sal* forests of the Division. With the exception of this limited area the great majority of the Jubbulpore forests are situated on rugged hilly ground.

Jubbulpore town itself is about 1,458 feet above sea level, and the average elevation of the forests of the Division may be put at about 1,500 feet.

The climate is moderate for this region of India. The hot season may be said to extend from the middle of March to the middle of June, the rains from the middle of June to the middle of October, and the cold season from the middle of October to the middle of March. In 1882 the readings in the shade, at the Civil Station, Jubbulpore, were as follows in the three months which may be considered typical of the three seasons :—

May,	highest	111·9°F.	lowest	68·0°F.
July,	„	92·4°F.	„	70·1°F.
December,	„	82·8°F.	„	41·2°F.

Casual observations, taken while camping through the Division, during several hot seasons, showed that the temperature in the tent never rose above 110°F. The maximum temperature is often reached comparatively early in the hot season, but occasional thunderstorms prevent the temperature becoming excessive, and the character of the season naturally depends on the frequency or otherwise of these storms.

The average annual rainfall at Jubbulpore up to the years 1886 is returned at 52 inches. Readings taken at different placen in the district, during the eight years following 1886, gave at average of 55 inches, the rainfall being greatest (64 inches) at Jubbulpore in the south of the area, and least (48 inches) as Bijeragogarh, near the laterite area in the north. Most of the year's fall is received during the south-west monsoon, the winter rains being variable and sometimes failing entirely. Occasionally years of deficient rainfall result in disastrous droughts, which cause great damage to the forest growth. This happened in 1899. The effect of the partial failure of the rains of that year on the forest growth was first manifested in the unusually early flowering of various species Thus *chiola* (85) which, in ordinary years, does not here flower until March, was found in full flower on January 10th, 1900, and other species behaved similarly. Deciduous trees also shed their leaves earlier than usual, and

the young foliage appeared unusually early. All trees had then to undergo an exceptionally long hot season, the store of moisture in the soil, springs, tanks and streams being very small. The results were most disastrous, and were perhaps most clearly shown in the case of the evergreen mango (75). The terminal twigs and the ends of the branches first began to die, the damage then spreading, in many cases, until the whole crown had, completely withered, showing clearly that the roots were unable to obtain sufficient moisture from the soil for the maintenance of the transpiring leaf surface. When the deciduous trees put out their young foliage, practically the same thing happened to them. In June 1900 many *sal* were found to have been killed and *teak*, *dhawa* (151) and others were similarly affected, until the forests were filled with dead and dying trees. Special fellings were then undertaken, in the case of *teak*, with the object of utilizing the dead and dying trees, all those which were still green below, being carefully coppiced, in the hope that a fair coppice regrowth might be obtained. It will be interesting to note the results of these operations.

In these forests, where frequently there is only a demand for a few species and the revenue is not sufficiently large to justify the expenditure required for coppicing all the inferior species on any given area, it is important to note to what extent, if at all, good coppice regrowth of the best species can be expected, when only a few stems are cut here and there. Until this is known it is impossible to decide as to whether timber can be sold under present conditions from such areas, without ruining the forests, or not. With reference to the results of the abovementioned operations, it will probably be difficult to decide whether inferior coppice regrowth is due to want of sufficient light, or to the weakening effect of the drought on the stools. I have, however, seen cases where good coppice shoots have been obtained from both *teak* and *tinas* (90) stools, seattered in fairly dense forest, and I think that fair coppice growth may be expected where the forest is not exceptionally dense, or the bamboo (345) unusually thick.

The cold weather is here often severe. Near Kundam, which lies in the south of the tract, in the neighbourhood of teak forests, the thermometer has been recorded as low as 26°F., and the forest vegetation suffers severely from frost, especially in the north of the area. It may be interesting to note that, in the adjoining district of Damoh, in the beginning of January 1899, I found thick ice in the *garhas* standing in my tent verandah, and found teak saplings, 30 feet in height, with all their leaves and young shoots frozen. The most severe frosts occur in December—January.

With regard to the comparative susceptibility of the various species to frost damage, I have made a few observations, according

to which the species noted on have been arranged in the following classes :—

Class I.—Frost-hardy ...	*Chind*	...	(342	*Khajuri*	...	(341)
	Ber	...	(62)	*Khair*	...	(126)
	Reonjha	...	(125)	*Karhār*	...	(174)
	Bilsena	...	(41)	*Karonda*	...	(198)
	Ramna	...	(128)	*Gurār*	...	(127)
	Bamboo	...	(345)	*Tinas*	...	(10)
	Bel	...	(48)	*Jamrassi*	...	(60)
Class II.—Less hardy ...	*Dhawai*	...	(158)	*Pāral*	...	(243)
	Gūlar	...	(315)	*Koha*	...	(149)
	Saj	...	(150)	*Dhawa*	...	(151)
	Harra	...	(148)	*Mango*	...	(75)
	Chiola	...	(85)	*Seji*	...	(160)
	Ghanto	...	(192)	*Tendu*	...	(190)
Class III.—Frost-tender	*Ashto*	...	(105)	*Aunla*	...	(302)
	Chār	...	(76)	*Kanker*	...	(11)
	Makor	...	(61)	*Ghont*	...	(65)
	Ganja	...	(73)	*Pānsi*	...	(94)

This list has been compiled from the observed effects of frost on the various species in this area, individuals of approximately the same age and standing near one another in the same locality having been compared as far as possible. This list cannot, as yet, be regarded as at all final, and it is hoped that further observations will be made to verify it and to include additional species.

There is no doubt that frost is a very real danger to the forests of this Division, and particular attention must be paid to this point when carrying out the *coppice with standard fellings* prescribd by the Working Plan. The protection that is afforded to the coppice by a few additional small standards is very considerable, especially if the standards maintain their old leaves until January. This was strikingly shown in the exceptionally severe frost of December 1902, in the adjacent coupes 1 and 29 of Block 12. In the latter coupe a few more standards had been kept and the coppice was very little damaged, whereas in coupe 1, which had fewer standards, nearly all the coppice shoots had been cut.

The *sal* forests in the north of the area near Khitoli are particularly liable to frost damage. The excellent photograph taken by Mr. Lovegrove in the Chokam Valley of the Ganges Division, illustrating the effect of frost damage on *sal*, which was published in the *Indian Forester* for December 1901, might well have been taken in portions of the Khitoli forests, the injured hop-pole-like trees being very characteristic. I visited the Khitoli forests shortly after the unusually severe frost of December 1902, and the effect was most remarkable. In places every leaf of not only *sal*, but also of the other scattered inferior species was brown, and the entire forest looked as if it had been burnt. Every single leaf on a fine *sal* pole, 52 feet in height, was seen to have been killed, but as a rule in other parts of the forest the upper shoots of the large trees, above a height of 30 feet, had escaped injury.

In February and March hailstorms are common. In February 1901 I noticed the effect of a severe hailstorm on the young coppice growth in Block 12, in the north of the area. Coriaceous leaves, such as those of *Butea frondosa* (85) were riddled with holes, exactly as if they had been perforated with large shot, the tissue having turned brown near the holes. More delicate leaves had been torn into fragments, while the bark on the shoots was more or less bruised and torn.

A considerable number of insect pests occur in these forests, regarding which the following few notes have been collected :—

Pyrausta machœralis and Hyblaea puera.—Both these notorious defoliators of the *teak* tree are common within the area. *Pyrausta* larvæ may almost invariably be found on the teak leaves from June to November and, as a rule, they are far more numerous than are those of *Hyblaea*. I have never, however, seen such severe damage done to the mixed forests of this Division by *Pyrausta* as I have noticed in the practically pure teak forests, on the dry sandstone hills, in parts of the adjoining district of Damoh. As a rule very few *Hyblaea* larvæ are to be found on the teak, although they are generally present in considerable numbers on the *Millingtonia hortensis* (241) trees planted in gardens and avenues in and near Jubbulpore station, and probably occur similarly on other species of *Bignoniaceæ* in the forests. In normal years, however, the damage done by *Hyblaea* is insignificant, but when the season is particularly favourable for the insect and the larvæ occur in large numbers, not only the *teak* but several other species as well are completely defoliated over large areas. A severe attack occurred in July 1900, when the following trees were noticed as having been more or less completely defoliated :—

Millingtonia hortensis; teak, *Albizzia Lebbek* (121), *Anogeissus latifolia*, *Adina cordifolia*, *Stephegyne parvifolia* and *Terminalia Chebula* (harra).

A description of these two insects and of their life-history in this locality, by the present writer, appeared in the "Journal" of the Bombay Natural History Society for June 1904, Vol. XV, No. 4.

Harra Gall Insect.—The *harra* flower is very commonly attacked by a gall insect, bunches of small, round, dark-red galls being formed instead of the normal myrobalans, the red galls being very conspicuous in August—September against the full green of the foliage. I sent specimens of these galls to the Indian Museum in October 1900. The insects which emerged from the galls were pronounced to be chalcids and were forwarded to Monsieur André in France for identification. The latter, however, was unable to do more than identify the insects as chalcids, and he surmised that they were parasitic on the cynipids which produced the galls.

Trigonodes ino.—The larvæ of this Noctuid moth were found by me in May 1901 defoliating *Ficus religiosa*, which had then just put out its young foliage. The larvæ are voracious night feeders and trees attacked are rapidly defoliated.

Pongamia glabra "*leaf-miner*".—The leaves of this tree are frequently severely attacked by a leaf-mining insect. Specimens of larvæ and pupæ were sent by me to the Indian Museum in August 1901, but no imagos were obtained and the insect could not be identified. The damage done resembles that of *Orchestes fagi* on beech in Europe, and the foliage of the attacked trees becomes a dull brown, just as if it had been frozen or scorched by fire.

Pongamia glabra "*seed insect.*"—A large percentage of the seeds of this tree are commonly destroyed by a large, stout larva dark blue or purplish in colour. The eggs appear to be laid in the young ovules or seeds, remaining quiescent there until the seed matures. The larvæ then hatch out, devour the seed, and finally make their escape by eating their way through the hard indehiscent pod. To enable it to do this the larva appears to exude a red fluid, which possibly softens the thick hard pod, and the inside of the pod, near the exit hole, is usually stained red, as if it had been saturated with a red fluid.

Premna latifolia "*defoliator.*"—This tree was defoliated by a larva in October 1900. The specimens collected died and I was unable to identify the insect. The larvæ leave the trees in the beginning of November, and appear to hibernate in the ground. They destroy the whole leaf tissue, leaving only the midrib and main lateral veins and, when feeding, they construct a compact white weft on the leaves under which they lie.

The variety of geological formations occurring in the area is considerable. All of the following are represented within the limits of the reserves :—

Alluvium.
Laterite.
Trap.
Lametas.
Upper Gondwanas.
Upper and Lower Vindhyans.
Bijawars.

The disintegration of the various rocks naturally results in the formation of soils of widely different characteristics, ranging from the loose sands of the Upper Gondwanas to stiff black soil from the scanty deposit on the Vindhyan plateaus of sheet rock to the deep alluvium on low-lying ground.

Although both *teak* and *sal* occur within the area, neither is here at its best. Naturally rather poor, these forests have further deteriorated under the old régime of irregular felling, unchecked forest fires and over-grazing, and wandering patch

cultivation. Naturally, then, these forests contain a large proportion of scrubby, crooked growth, consisting principally of old coppice and pollard shoots. Natural regeneration by seed is as a general rule exceedingly slow and unsatisfactory. (As an exception *Dendrocalamus strictus* may be noted. This species flowered throughout the Division about 1893, and magnificent reproduction resulted.) We are here at the northern limit of *teak* and the western limit of the Peninsular area of *sal*. The limiting line of teak enters the Division on the east in the neighbourhood of 23°30' N. lat., and thence extends across the area in a west north-west direction. Attempts were made, several years ago, to introduce teak into the Khitoli *sal* forests lying to the north of this line. Several plants are still existing, but the shoots sent out from the rootstocks are killed down annually by the frost; thus indicating that temperature is mainly responsible for limiting the distribution of *teak*.

From the Forest Officer's point of view the forests of the Division fall into three main types: (I) *sal* forest, (II) *teak* forest, (III) mixed forest with practically no *teak* or *sal*.

Sal forest.—The sal nowhere exceeds 80 feet in height, and the average is about 60 feet.

Practically all the largest sound trees were removed from these forests to supply sleepers for the construction of the East Indian Railway, but fine trees are occasionally met with, which show that the area is capable of producing large timber. The following may be cited as instances :—

A tree cut in 1867 is said to have yielded 300 cubic feet of sound timber. Another, found lying in the forest in 1875, had a basal diameter of 4 feet. In this latter year also, two standing trees were measured, and girthed respectively 8 feet 9 inches and 9 feet 2 inches.

During the recent sleeper operations, I measured a sound tree in Block 25 with a girth of 11 feet 3 inches. The forest contains the usual characteristic groups of nearly pure *sal*, alternating with open, grassy blanks, while the higher portions are occupied by miscellaneous species. The most remarkable point regarding these forests perhaps is the poverty of the reproduction of *sal* and the almost total absence of good *sal* advance growth. This is found to be the case in forests which have been closed to grazing and protected from fire since 1871. These forests suffer severely from frost, especially near Khitoli.

The *sal* is practically confined to the sandstones and conglomerates of the Gondwanas, and its extension westwards is abruptly checked when it comes in contact with the trap rocks.

Teak forest.—This is practically ordinary mixed forest with the addition of a varying proportion of *teak*. *Teak* is almost wholly confined to the hilly portions of the trap and Vindhyan areas, attaining its largest dimensions and being most numerous

on the trap. In the trap area, the trees on the tops of the hills are usually stunted, crooked and much branched, those on the slopes are most numerous and show the best growth, and those on the alluvial black soil in the valleys are usually of large girth, with buttresses and much branched. The latter contain a large proportion of sap-wood. Trees of large dimensions are scarce, owing principally no doubt to the best trees having been removed, under the old unregulated fellings, by the railway contractors. The average dimensions of the best trees now available are a height of about 50 feet and a girth of 3½ feet. The best teak forests usually contain a strong admixture of bamboo (*Dendrocalamus strictus*).

Mixed forest.—This is the most widely distributed type. The species most commonly found are—*dhowa* (151), *seji* (160), *saj* (150), *ghont* (65), *khair* (126), *tendu* (190), *mahua* (187), *char* (76), *aunla* (302), *salei* (51), *kulu* (30), *gunja* (73), *kenkar* (52), *tinas* (90), *kaim* (170), *chiola* (85). Slight variations in the local conditions of soil, aspect, etc., naturally affect the composition of the crop, and a number of subsidiary types are formed, which cannot be noticed in detail here. The dense growth of *siharu* (196), commonly seen on the low laterite hills, in the north of the area, is however sufficiently noticeable to deserve mention. To some extent at least, these thickets of *siharu* have, I believe, resulted from the indiscriminate coppicing of forests of the ordinary mixed type. The coppice growth of *siharu*, in such places, is far more vigorous at first than that of the other species with which it is associated, and the latter are gradually ousted in the struggle for existence. These forests have generally been subjected to heavy irregular fellings in the past, and trees of the better timber species, of large dimensions, are rarely found. They seldom exceed 50 feet in height and 3 feet in girth, and are usually much smaller than this, except in the more remote portions of the Sihora and Dhanwahi Ranges, where large specimens of *bija* (97), *dhawa* (151), *saj*, *tendu*, *tinas*, and others are sometimes seen.

No great attention, however, is at present paid to the question of the development of large timber in this type. The best of the timber species are very sparsely scattered over a large area, and the possibility of their profitable exploitation, for any exterior demand which may arise in the future, is very doubtful. At present, the demand for the better species, in this type, is entirely a local one, for poles for the construction of small buildings and agricultural implements, and there is practically no demand for large timber, *teak* and *sal* being almost invariably employed for construction in the better class of buildings and for most purposes for which large timber is usually required.

The present system of management wherever the demand makes systematic management possible is improvement fellings in the *sal* forests and coppice with standards everywhere else,

care being of course taken, in the case of *teak*, to favour as far as possible the production of good large timber. With these preliminary observations the list of species found in this locality is now given below without further remarks :—

LIST OF SPECIES.

ANONACEÆ.

(1) POLYALTHIA LONGIFOLIA. Vern. *asok.*
F. B. I. I. 62. Br. 4.
Fl. March - April; commonly planted in gardens and avenues.

(2) SACCOPETALUM TOMENTOSUM. Vern. *kūri.*
F. B. I. I. 88. Br. 7.
Fr. May – June.

(3) ANONA SQUAMOSA Vern. *chitaphal.*
F. B. I. I. 78. Br. 6.
Almost wild near Jubbulpore.

MINISPERMACEÆ.

(4) CISSAMPELOS PAREIRA.—
F. B. I. I. 103. Br. 10.
Fl. February.

(5) COCCULUS VILLOSUS.—
F. B. I. I. 101. Br. 9.
Fl. December; fr. February.

PAPAVERACEÆ.

(6) ARGEMONE MEXICANA —
F. B. I. I. 117.
Fl. Cold season.
Robust herb; common weed of waste places.

CAPPARIDEÆ.

(7) CAPPARIS HORRIDA. Vern. *aundha.*
F. B. I. I. 178. Br. 15.
Fl. February—March.

(8) CAPPARIS APHYLLA. Vern. *karīl.*
F. B. I. I. 174. Br. 14.
Fl. hot reason.
Planted in gardens.

(9) CRATAEVA RELIGIOSA.—
F. B. I. I. 172. Br. 16.
Fl. April.
Planted near Jubbulpore.

BIXINEÆ.

(10) COCHLOSPERMUM GOSSYPIUM. Vern. { *gabdi.* / *ganīar.* }
F. B. I. I. 190. Br. 17.
Fl. hot reason, when tree is bare.

(11) FLACOURTIA RAMONTCHI. Vern. { *kanker*. (Hind.) / *kakai*. (Gondi.) }
F. B. I. I. 193. Br. 18.
Fl. February after fall of leaves.
Fr. April—May; young leaves appear April.

TAMARISCINEÆ.

(12) TAMARIX DIOICA.—Vern. *jhau*.
F. B. I. I. 249. Br. 21.
Seed ripens February.

(13) TAMARIX ERICOIDES. Vern. *jhau*.
F. B. I. I. 249.
Fl. December, seed ripens cold season.

DIPTEROCARPAÆ.

(14) SHOREA ROBUSTA. Vern. *sarei*.
F. B. I. I. 306. Br. 26. The *sal* tree;
young leaves in March—April with the flowers.
Seed is cooked and eaten with *mahua* flowers, but said to be unwholesome.

MALVACEÆ.

(15) THESPESIA LAMPAS. Vern. *bankapās*.
F. B. I. I. 345. Br. 28.
Fl. August—October; fr. cold season; an undershrub of shady forests; is never a tree.

(16) KYDIA CALYCINA. Vern. { *barga* (Hind). / *baranga* (Gondi). }
F. B. I. I. 348. Br. 29.
Fl. in rains; fr. remaining on tree through cold season.

(17) BOMBAX MALABARICUM. Vern. *semal*.
F. B. I. I 349. Br. 31.
Leafless December—May; fl. hot season.

(18) URENA LOBATA.—
F. B. I. I. 329.
An undershrub of waste places;
fl. cold season and rains.

(19) URENA SINUATA.—
F. B. I. I. 329.
Small undershrub of waste places.
fl. cold season.

(20) HIBISCUS ROSA SINENSIS.—
F. B. I. I. 344. Br. 28.
Common in gardens.

(21) H. ESCULENTUS. Vern. *bhendi*.
F. B. I. I. 343. Br. 28.
Commonly cultivated.

(22) H. PANDURAEFORMIS. Vern *banambāri.*
F. B. I. I. 338
Large herb; common in hedges;
yellow flowers, cold season.

(23) H. PIRTUS —
F. B. I. I. 335.
Fl February;
small shrub; cultivated.

(24) H. CANNABINUS. Vern. *ambāri.*
F. B. I. I. 339.
Cultivated.

(25) H. ABELMOSCHUS. Vern. *banberi.*
F. B. I. I. 342.
Tall herbaceous plant. The erect leafless stems, bearing the capsules and occasionally large yellow flowers, being very noticeable in the hedges in the cold season.

(26) ABUTILON INDICUM. Vern. *tepāri.*
F. B. I. I. 326.
Fr. cold season. A common weed.

(27) SIDA SPINOSA.—
F. B. I. I. 323.
Small shrub of waste places.
Fl. January—February.

(28) GOSSYPIUM HERBACEUM. Vern *kapās.*
F. B. I. I. 346.
The common cotton; widely cultivated.

(29) G. BARBADENSE.—
F. B. I. I. 347.
Occasionally cultivated in gardens.

STERCULIACEÆ.

(30) STERCULIA URENS. Vern. *kulu.*
F. B. I. I. 355. Br. 33.
Leafless November – May; young leaves end of May and June.
Fl. February. A very characteristic tree of dry rocky hills. In forests which have been burnt a remarkable contrast of colour is some time afforded in June by the black of the ground, the dark pink bark and bright green of the young leaves of this species.

(31) HELICTERES ISORA. Vern. *enthi.*
F. B. I. I. 365. Br. 34.
Common shrub. Fl. in rains;
ripe fruit in cold season.

(32) PTEROSPERMUM ACERIFOLIUM. Vern. *machkund.*
F. B. I. I. 368. Br. 35.
Planted in avenues and near villages. Fl. April.

(33) ERIOLAENA HOOKERIANA. Vern. *bhonti*
F. B. I. I. 370. Br. 36.
Fl. rains. Fruit cold season.

TILIACEÆ.

(34) GREWIA HIRSUTA. Vern. *gursakri.*
F. B. I. I. 391.
Fl. rains; fruit cold season.
The ripe, orange-coloured drupe has a very pleasant flavour.

(35) G. SALVIFOLIA. Vern. *kursi, barsala, ghatyāri.*
F. B. I. I. 386. Br. 43.
Fl. rains. Fruit cold season.
Drupe globose, purple.
A shrub, common and attaining a considerable size in *sal* forests.
I have noticed leaves up to 5½ inches in length and 2¼ inches in breadth, which I believe belong to G. *excelsa.*
F. B. I. I. 385.

(36) G. TILIAEFOLIA. Vern. *dhamin.*
F. B. I. I. 386. Br. 41.
Fl. rains.

(37) G. ASIATICA. Vern. *phalsa.*
F. B. I. I. 386. Br. 40.
Cultivated.

(38) TRIUMFETTA ROTUNDIFOLIA.—
F. B. I I. 395.
Small shrub in dry places.
Fl. February.

LINEÆ.

(39) LINUM USITATISSIMUM. Vern. *alsi.*
F. B. I. I. 410.
The common linseed; widely cultivated.

MALPIGHIACEÆ.

(40) HIPTAGE MADABLOTA. Vern. *kampthi.*
F. B. I. I. 418. Br. 44.
Fl. March. In damp places.

RUTACEÆ.

(41) LIMONIA ACIDISSIMA. Vern. *bilsena.*
F. B. I. I. 507. Br. 47.
Fruit cold season.

(42) MURRAYA EXOTICA.—
F. B. I. I. 502. Br. 48.
Cultivated in gardens.

(43) M. KOENIGII. Vern. *kāripāt.*
F. B. I. I. 503. Br. 48.
Fl. March.
Cultivated in gardens.
Found once or twice some distance from villages, but doubtful if wild.

(44) CITRUS MEDICA.—
F. B. I. I. 514. Br. 51.
(45) C. AURANTIUM.—
F. B. I. I. 515. Br. 53.
(46) C. DECUMANA.—
F. B I. I. 516. Br. 55.

Cultivated in gardens.

(47) FERONIA ELEPHANTUM.—
F. B. I. I. 516. Br. 56.
Vern. *kaitha, katbel.*
Not truly wild; common near villages.

(48) AEGLE MARMELOS.—Vern. *bel* (Hindi); *mahaka* (Gondi).
F. B. I. I. 516. Br. 57.

(49) CLAUSENA WAMPI.—
F. B. I. I. 505.
Cultivated in gardens.
Fl. hot season.

SIMARUBEÆ.

(50) AILANTHUS EXCELSA Vern. *maha nim.*
F. B. I. I. 518. Br. 58.
Fruit March.
Planted in gardens and near villages.

BURSERACEÆ.

(51) BOSWELLIA SERRATA Vern. *salei.*
F. B. I. I. 528. Br. 61.
Fl. February—April, when the tree is leafless. Young leaves appear June; common on dry, rocky hills, often with *Sterculia urens* and *Odina Wodier.*

(52) GARUGA PINNATA. Vern. *kenkar.*
F. B. I. I. 528. Br. 62.
At a distance this tree somewhat resembles *Odina Wodier*, with which it often occurs, but in this locality they may be readily distinguished in autumn by the fact that the leaves of *Garuga* then turn crimson in colour while those of *Odina* are bright yellow.

MELIACEÆ.

(53) MELIA AZADIRACHTA. Vern. *nim.*
F. B. I. I. 544. Br. 67.
Flower and young leaves in March.

(54) MELIA AZEDARACH. Vern. *bakain, bara nim.*
F. B. I. I. 544. Br. 68.
Young leaf and flowers in hot season. Has a striking appearance in the cold season when it is leafless and covered with bunches of yellow fruit.
Planted in avenues and near villages.

(55) SOYMIDA FEBRIFUGA. Vern. *rohan, rohni.*
F. B. I. I. 567. Br. 71.
Fl. hot season when young foliage appears.

(56) CHLOROXYLON SWIETENIA. Vern. *bhira, girya.*
F. B. I. I. 569. Br. 74.
Fl. and young leaves March—April.
Usually on sandstone or limestone.

OLACINEÆ.

(57) OLAX SCANDENS. Vern. *kakundan, adhanipāri.*
F. B. I. I. 575. Br. 75.

CELASTRINEÆ.

(58) GYMNOSPORIA MONTANA. Vern. *bekal.*
F. B. I. I. 621. Br. 81.
(Syn *Celastrus senegalensis.*)

(59) CELASTRUS PANICULATUS. Vern. *wārangar, kakūndan.*
F. B. I. I. 617. Br. 82.

(60) ELŒODENDRON GLAUCUM Vern. *jamrassi.*
F. B. I. I. 623. Br. 82.
Leaves shed in March ; young foliage June ; flower cold season.

RHAMNEÆ.

(61) *ZIZYPHUS OENOPLIA. Vern. makor.*
F. B. I. I. 634. Br. 86.
Fruit ripens cold season.

(62) Z. JUJUBA. Vern. *ber.*
F. B. I. I. 632. Br. 86.
Common on and near old village sites and in areas which at one time or another have been under cultivation. Its mode of occurrence conveys the impression that the tree was originally introduced and has run wild from cultivation. *Two varieties are locally distinguished, viz.* (1) the wild form, *dakera ber*, the globose fruit of which ripens in December—January, and (2) the cultivated form *sarra ber*, the fruit of which is oblong and ripens in February—March. The fruit of both is largely eaten, and has a more pleasant flavour than that of the next species.

(63) Z. NUMMULARIA. Vern. *jaria ber.*
F. B. I. I. 633. Br. 88.
This plant is always a small shrub or bush, never a tree, and forms large straggling clumps in hedges and near villages.

The fruit, which ripens in December, is widely eaten, but has a peculiar sickly flavour.

(64) Z. RUGOSA. Vern. *sagra*.
F. B. I. I. 636. Br. 89.
Fl. March—April; fruit May—June. Leaves shed April.

(65) Z. XYLOPYRUS. Vern. { *ghont.* *ghuter.* *ghatōla.* }
F. B. I. I. 634. Br. 90.
Fl. April; fruit ripens cold season.
Often gregarious in dry, stony situations. One of the principal trees for the production of lac.

(66) VENTILAGO CALYCULATA. Vern. *keoti*.
F. B. I. I. 631. Br. 96.
Fl. cold season.

(67) HELINUS LANCEOLATUS.—
F. B. I. I. 644. Br. 574.

AMPELIDEÆ.

(68) VITIS LATIFOLIA. Vern. *dokarbela* (Hindi); *doto* (Gondi).
F. B. I. I. 652. Br. 99.
Fl. August—September. Fr. September—December.

(69) V. CARNOSA.—
F. B. I. I. 654. Br. 101.
Common in hedges. Fruit cold season.

SAPINDACEÆ.

(70) SCHLEICHERA TRIJUGA. Vern. *kosam*.
F. B. I. I. 681. Br. 105.
Young foliage March.
Fl. April.

(71) SAPINDUS TRIFOLIATUS (EMARGINATUS Vahl). Vern. *rithi*.
F. B. I. I. 682. Br. 107.
Planted near villages.
Fl. November. Fr. February—April.

(72) CARDIOSPERMUM HALICACABUM.—
F. B. I. I. 670.
Fl. cold season. Fruit January—February.

(*To be continued.*)

Fire Protection.

A Suggestion.

Although most readers of the *Indian Forester* are probably not averse to a rest from fire protection during the off season, I venture to briefly discuss one aspect of this subject in the hope of eliciting criticism.

In most divisions the ever-recurring annual expenditure on clearing guide lines and boundaries probably constitutes about 50 per cent of the total fire-protection charges and entails the devotion of considerable time and trouble, which might be more profitably employed. Quoting from the accounts of my present division, taking averages for three years, the expenditure on clearing lines bears the proportion of 4 to 5 to the combined expenditure of burning the lines and maintaining a special protective staff.

The cost of burning lines and pay of fire-patrols must persumably remain more or less a constant, but it should be possible to devise some effective means by which guide lines and boundaries may be kept permanently clear without any prohibitive initial outlay.

The usual absence of vegetation under the shisham trees, probably due to the products of decomposition of its fallen leaves, offers perhaps a solution to the problem.

May not the fire lines of the future—where climatic conditions permit—be wide avenues of shisham trees, the area under their crowns being natural guide lines, clear of vegetation and with but a thin sprinkling of leaves and thus less dangerous than the grass stubble so common on cleared guide lines; the leaves could be easily swept away from the grass-covered fire line just before the time for burning arrives.

The young shisham trees might be planted on each side of a fire line about five feet from the margin of the forest and, in the case of boundaries, a few feet to the forest side of the line joining the centres of the boundary posts or pillars.

The initial expenditure of planting would probably in the case of shisham turn out to be a profitable investment in any case. On their attaining an exploitable size alternate trees could be removed, the gaps being planted up, and a few years allowed to lapse before felling the remaining mature trees so as to maintain continuity of cover as far as possible.

In parts of India where the shisham will not thrive possibly other species which drop their leaves before the hot weather and kill out vegetation underneath their crowns by the density of their foliage might be found to answer the same purpose.

E. R. Stevens.

Dehra Dun:
17th August 1904.

III.—OFFICIAL PAPERS AND INTELLIGENCE.

Rubber-producing Plants in Burma.

Little is known about the great majority of the numerous rubber-producing plants which exist throughout Burma, and with the present day enormous consumption of rubber for various purposes, the recent action of the Burma Government * in causing enquiries to be made into the qualities of some of the known rubber-producing plants is very opportune.

Attention has been confined principally for the present to Parameria glandulifera and Chavanessia esculenta, two creepers which, besides having been tried in plantations, are of common occurrence in the hills and on most lands which stand above flood level. It is reported that the extension of cultivation and of *taungya* clearings has reduced the area over which they are to be found, but there must still be extensive tracts on which those two species abound.

The enquiry originally aimed at ascertaining the market possibilities of these two rubbers, but at first the object of the enquiry was lost sight of, and the experiments were carried out on too small a scale to be of much practical value in supplying data for the cost of collection, preparation and freight. Unless these be favourable, the best rubber in the world may have no commercial value.

Experiments carried out with the latices of the two rubbers show that coagulation takes place naturally in both cases in about 48 hours. The addition of small amounts (15 drops) of creosote and acetic acid had no effect in either case in expediting coagulation. A small pinch of alum added to the latex resulted in instantaneous coagulation in both cases.

Specimens of both rubbers were sent to the Reporter on Economic Products to the Government of India, who gave his opinion that judging from the specimens received good rubber could be got in many ways from both species. Fresh samples have been sent to the Imperial Institute for analysis in order to ascertain the percentage of resin in the latices—an important point; with this information and a knowledge of the cost of preparation and freight and the supply available, the Department should shortly be able to say what are the possibilities of those two rubber species in Burma.

What is believed to be an important discovery in connection with the production of rubber has been made by Mr. Stearsey, Extra Assistant Conservator of Forests. He has reported that the creeper *Rhynchodia wallichii*, Bentham, which abounds on lands submerged to a depth of 10 or 12 feet during floods, yields a good rubber. He has forwarded some samples of the rubber, which are described as excellent; samples have been to the Imperial Institute for analysis and valuation.

* From correspondence communicated to the Editor by the Government of India.

Green Leaves for Manure.

Throughout a very considerable portion of Madras a large demand exists for green leaves as manure for wet cultivation. The loppings of trees are strewn on the wet fields and are ploughed in and allowed to decay. The cultivator makes use of almost any soft-leafed species, but those most in favour are —*Cassia auriculata*, *Pongamia glabra*, *Tephrosia purpurea*, *Dolichan-drone crispa*, and *Calletropi gigantea*.

For some time past the Madras Government * have been considering what measures should be adopted to further the use of leaves for this purpose and to increase the supply available in Reserved Forests. It has now been decided to select some large areas of land for this purpose. If these are intelligently selected and are worked under some system of pollarding or coppicing with a view solely to their leaf-yielding capabilities, much good may be anticipated. To combine the production of leaves for manure with the yielding of timber or even fire wood will be practically impossible. Nor is it desirable, as the intention is to meet an already existing demand in the manner most suited to the requirements of the cultivating classes.

Fairy Tales for Forest Folks.

I trust I am not guilty of betraying official secrets in sending you a copy of an interesting note drawn up by Maung Po Sein, Accountant in the Office of the Conservator of Forests, Pegu Circle, Burma, anent the correct spelling of the Burmese names of plants. It seems that there is quite a treasury of fairy legend or of folk-lore in these names, which may lend and interest to the search for economic products that are so frequently asked for now-a-days. The legend communicated by Maung Po Sein was elicited in connection with the collection of *Clerodendron inerme*, Gaertn, for which the name *Kyaungban* (cat's flower) had been supplied. Maung Po Sein informs us that this is the Burmese name of another but closely allied plant, *viz.*, *Vitex agnus castus*, L. (var. *V. trifolia*), whilst *C. inerme* is called Pinlé,-Yé-, or Sin-Kyaungban, and he relates a pretty fairy tale

to explain the correct spelling of *Kyaungban* in the vernacular. The book, edited by an Admiral of the Burmese Fleet of Royal Boats, would be very interesting to those acquainted with Burmese who make a study of folk-lore. The dedication of Major Prain's *Bengal Plants* to Mr. H. H. Risley, C. I. E., shows how the study of plants is linked with the study of ethnology.

F. B. MANSON.

KYAUNGBAN.

With reference to the Conservator's question of yesterday I respectfully beg to submit herewith a legend in connection with Kyaungban plants, together with specimens of two kinds of Kyaungbans which I can procure in Rangoon.

Specimen (1)—Kyaungban.

Specimen (2)—Ye Kyaungban, Pinlé Kyaungban, or Sin Kyaungban.

Legend.—Once upon a time a man begged of a woman who was far advanced in her pregnancy to give him her daughter in marriage on her issue. The woman replied "My child, it is hard to foretell what will be the issue and I cannot say whether it will be a cat or rat."

"Dear mother," said the man, "it is quite true, but I won't refuse to take whether your child be a cat or a rat." They mutually agreed on this point, and when after some months the woman gave birth to a female kitten, the man according to his promise had to take it. The man used to carry the cat tied up in a basket and slung on his shoulder. One day the string gave way and the basket dropped on a bush. On his looking to the cause of this, he found to his utter amazement that his cat became a beautiful young woman.

The plant on which the cat dropped down was therefore called 'cat's-flower' plant.*

Please see page 186 of the book edited by an Admiral of Burmese Fleet of Royal Boats. In this book derivations and legends of Burmese common names are shown.

Use of the Plants in Burma.

Specimen 1. Its use, as far as I know, is good for medicines, for removing wind in bowels and stomachs and also for stomach-aches, and for protecting children from getting bad smell. Its leaves are sometimes used in preparing broth. They are sometimes *prepared as pickled tea and used as food.*

Specimen 2. *Pinlé Kyaungban, Ye Kyaungban, or Sin Kyaungban.*

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* We are unable to give the Burmese word as Burmese type was not procurable in India.—Hon. Ed.

I never saw the plant used as a food-stuff or for internal medicine. Its green leaves are used as an application for sores and itches after grinding them properly.

Mg. Po Sein.

The Nilgiri Game Rules.*

A curious case has recently been decided by the Government of Madras in connection with the Nilgiri Game Rules.

As is commonly known, a most praiseworthy and go-ahead Association, known as the "Nilgiri Game Association," has been in existence for a number of years in the Southern Presidency, its object being the preservation of the game in the Nilgiri and Coimbatore districts by limiting the number of head killed per *annum* and endeavouring to strictly enforce a close season for all game. To this end Government had sanctioned a set of Nilgiri Game Rules, and an annual permit costing Rs. 30 had to be taken out by all wishing to enjoy any sport in these districts. In practice these game rules had been made to apply to both shooting and fishing, and in the interests of the latter sport the Nilgiri Game and Fish Preservation Association has at great expense stocked the rivers of the plateau, which are said to have contained formerly little but minnows, with English and Carnatic carp, tench and trout. As can be easily understood, this latter proceeding was only on the supposition, until recently never questioned, that the *Game Rules did also apply to the fishing of these streams.*

The annual license was formerly issued from the 1st July to 30th June, or for the fasli year. Last year the question arose as to the advisability of changing this date. It had been pointed out that a visitor arriving at Ootacamund in May on three months' leave with the intention of spending that period in *fishing the streams and rivers on the plateau had under the* present rules to take out a license which expired on the 30th June, and this entailed his taking out a second for the balance of his stay. In other words, a visitor's fishing cost him Rs. 60, whereas a resident would only be paying Rs. 30. At a meeting of the Association it was unanimously carried that the license should in future be made to hold good from September 16th to the following September 15th instead of the fasli year, as at present. An application to Government supported by the Collector of Ootacamund and the Conservator of Forests, Southern Circle, was accordingly sent up to Government for the necessary sanction to the alteration. The Board supported this resolution and sent it on to the Revenue Secretary. The reply from the latter was a startling one. It conclusively shows that the drawing up and putting into force of game laws to be applicable to either a part or the whole of a country like India, where their utter

* This article has been compiled from official papers very kindly placed at the disposal of the Editor by the *Government of Fort St. George.*

absence from time immemorial has led to a point where we are threatened with the extinction of portions of the fauna, must be approached with great caution. That such are urgently needed and on a much larger scale than at present in force for the country as a whole few who have studied the question would be found to deny. "No law," wrote the Revenue Secretary, "or authorised rules can be traced in the Government Office requiring that a license should be taken out for fishing in waters not closed absolutely to fishing, *vide* also G. O. No. 401, dated 8th June 1894. The reason urged by the Nilgiri Game Association for changing the period of the currency of the shooting license does not therefore apparently apply. The Collector of the Nilgiris is requested to report whether any other reason subsists for the proposed charge."

This letter raised the question as to whether the fishing in the rivers of the plateau was to be licensed or not. The G. O. 401, referred to above, decided that any restriction on fishing by raising the fees would injuriously affect the professional fishermen at Mattupalaiyam, who lived by fishing and were paying a small fee of Rs. 5 to the Coimbatore Collector for the privilege, and therefore was inadmissible. Ever since the receipt of that order the Mattupalaiyam fishermen had been exercising their profession unhampered in the two rivers Bhawani and Moyar, which were the only two rivers within the limits prescribed in the "Nilgiri Game and Fish Preservation Act" II of 1871, which contained any indigenous fish capable of forming food and frequented by professional fishermen. As has been already seen, the rivers and streams on the plateau contained no such fish, nor were there any professional fishermen in those hills. It had always been considered by the Collectors of Ootacamund and by the Honorary Secretaries of the Game Association, who were District Forest Officers, that the order did not apply to the rivers of the plateau, and it was on this supposition, even though it does not appear to be very evident how it could have arisen unsupported as it appears to have been by a single official declaration in its favour, that the large sums of money were spent by the Association in stocking the plateau rivers with imported fish.

The Collector in his letter states "that it was always thought that it was never meant by Government that the fishing of these imported and costly fish should be open to everybody free of all fees." Since neither he nor the Honorary Secretaries had ever questioned the validity of the rules under whose *quasi* protection the fish had been imported, it is not very apparent what idea the Collector intended to convey by these words. The serious question which had arisen is faced, however, in para. 4 of the letter. "As it now seems that Government relies on the letter of the order, even in respect of the imported fish, I request that orders of Government may be obtained for the conversion of

the present license, *viz.*, 'to hunt and shoot' into one 'to hunt, shoot and fish' in the streams of the Nilgiri plateau (the wording might, one would think, be amended with advantage), and for the provision of power to enable me to prescribe such necessary conditions and restrictions as may be decided by me in consultation with the Nilgiri Game Association." The Conservator, in forwarding this on to the Revenue Board, pointed out that neither the Collector nor the Association had the power to legalize the prohibition of fishing in the rivers and streams of the Nilgiri plateau, but that rules could be framed by the Collector and Game Association under the Forest Acts as amendments to the present rules for hunting and fishing, which rules could be submitted for the sanction of Government.

The Board, in recapitulating the above suggestions and proposals, stated that if Government approved of the proposal in principle it would be necessary to amplify rules 4 and 5 of the special rules to regulate the pursuit of game in the Nilgiris so as to include fishing in the streams of the plateau. Sections 21 and 26 of the Madras Forest Act would cover the contemplated addition to the present rules, and as neither of these sections affected existing private rights, no harm could, in the Board's opinion, result in applying the rules now proposed. It was only, they continued, when Madras Act II of 1879 (the Nilgiris Game and Fish Preservation Act) is applied, that private rights would be affected; it was not, however, now proposed to apply that Act as the rules the amplification of which is now suggested are framed under the Madras Forest Act. With reference to the question, raised by the Conservator, as to the authority which should sanction the rules, the Board considers that the amplification of the rules now suggested by it should receive the sanction of Government, minor details, such as the conditions of the license, being left to the Collector.

In their Order No. 483 Revenue, dated 11th May 1904, Government approved of the Board's proposals, but ordered that in the *addenda* to be made to the Nilgiri Game Rules care should be taken to specify the waters which are to be closed to non-licensees: and the privileges of indigenous fishermen in the Moyar and Bhawani rivers and in other waters, which are now as a matter of fact open, should not be interfered with. As regards the conditions of the license, the form of license now issued would, they presumed, require little alteration.

This order has ended a position which might have placed the Nilgiri Game Association in a serious predicament, and the far-sighted policy in altering the fishing year so as to remove what was undoubtedly a serious hardship to visitors should, and doubtless will, meet with its just reward from those sporting visitors who belong to that fraternity who class themselves as ardent disciples of the Great Isaac.

E. P. STEBBING.

Indian Pheasants and their Allies.

BY F. FINN, B.A., F.Z.S.

(*Continued from page* 227.)

CHAPTER IX.

QUAILS.—(*concluded.*)

The quails that remain to be dealt with all agree in having distinct tail feathers, though the tail is still short and inconspicuous in all except one species.

This one is the Mountain Quail (*Ophrysia superciliosa*), in which the tail is three inches long; of the rest, the two typical bush quails (*Perdicula*) are recognizable by their short, stout, almost bullfinch-like bills and their tail of twelve feathers, and the slight billed bush quails (*Microperdix*) by having a bill much like an ordinary quail's and ten feathers in the tail, which is more than half as long as the wing.

All the above birds are rather miniature partridges than quails, both in form and habits, the stout-billed bush quails especially, in which the males have a little knob on each shank, representing a spur.

THE JUNGLE BUSH QUAIL

Perdicula asiatica, Blanford, Faun. Brit. India, Birds, Vol. IV., p. 118.

Native names:—*Lowa*, Hind; *Juhar*, in Manbhum; *Auriconnai*, Sonthal; *girza pitta*, Telugu; *Kari lowga*, Canarese. The male of this species is brown above, mottled and pencilled with black and buff; the head is mostly of a bright chestnut with white eyebrows, and the underparts conspicuously barred across with black and white. The female has the same chestnut head, but no barring below, the whole plumage being a nearly uniform light brown.

The young have no chestnut on the head, and a brown plumage streaked with buff above and whitish below.

In all the pinion quills are plain brown on the inner web and spotted with buff on the outer.

The bill is black, the eyes brown, and the legs orange.

This, although a thick-set little bird, is decidedly smaller than the common or grey quail, being only a little over six inches long, with a wing of a little over three inches and tail about half as long.

It inhabits well-wooded tracts in the Indian Peninsula, and also in the northern part of Ceylon. It is almost always in little flocks, from half-a-dozen to more than twice that number going about together, shooting off in all directions when alarmed, but quickly collecting again. Their call is a long trilling whistle, something like that which forms so large a part of the song of the German "Roller" canaries. They live on grass-seed and

insects, and are themselves rather dry and not so good to eat as the true quails.

They breed from September to February, laying five to seven creamy-white eggs about an inch long in a nest of grass under the shelter of some bush or tussock. Although so sociable in a state of nature, they will fight in captivity, and are sometimes kept for this purpose by natives.

THE ROCK BUSH QUAIL.

Perdicula argunda, Blanford, Faun. Brit. India, Birds, Vol. IV., p. 119.

Native names:—*Lowa*, Hind. and Mahratta; *Lawunka*, Telugu; *Sinkadeh*, Tamil; *Kemp lowga*, Kanarese of Mysore. This species is very like the last, but is slightly larger, and differs in a few points in the plumage; there is more buff on the upper surface, the head is dull brick-red with no white eyebrow; the cock has broader bars below, and the hen a whitish chin and abdomen. But the chief difference is that the inner webs of the pinion quills are spotted with buff as well as the outer.

This species, like the last, is a bird of the Indian Peninsula, but has a more restricted range, nor is it found in Ceylon. It also affects more open and drier county, chiefly inhabiting sandy or rocky ground with scanty vegetation; its nest and eggs are like those of its ally, as are its general habits; it breeds in August and September and also in March.

The slight-billed bush quails, with longer tails and shorter wings than the above two species, and without spur-rudiments in the males, nevertheless closely resemble them in habits. Of the three species, two are very nearly allied, the third very distinct and formerly one of the very rarest of our birds.

THE PAINTED BUSH QUAIL.

Microperdix erythrorhynchus, Blanford, Faun. Brit. India, Birds, Vol IV., p. 121.

Native name:—*Kodai*, Tamil.

The general colour of this bird is brown warming into chestnut below, and distinctly spotted with black, the spots being especially large and bordered with white on the flanks and under the tail. The head of the cock is curiously marked with black and white, the chin, crown, and a patch round the eyes being black, while the throat and a band along each side of the head are white, the former having a black border; the hen's face is dull reddish, with no black and white markings. The legs and bill are bright red, a point which at once distinguishes this species and the next from all our other quails. Young birds are like the hen, but have the black crown, which is nearly or quite absent in females.

The cock, which is a little larger than the hen, is seven inches long, with a wing of three and-a-half inches and a two-inch tail.

This bird haunts the forests on and near the Western Ghauts, and is also common on the Nilgiris, while it has been obtained on

the Shevaroys. Its call is different from that of the stout-billed bush quail, and it flies less noisily, being a softer-feathered bird. The breeding season varies, being from August to April according to local circumstances; the eggs are simply laid on the ground, are pale glossy cream colour, and measure a little over an inch in length.

Blewitt's Bush Quail.

Microperdix blewitti, Blanford, Faun. Brit. India, Birds, Vol. IV, p. 122.

Native name:—*Sirsi lawa*, in the Central Provinces.

This is hardly a distinct species, differing from the painted bush quail only in being smaller and greyer, with a distinctly smaller bill and with more white and less black on the face of the male. It inhabits the forest region of the eastern Central Provinces.

Hume's Bush Quail.

Microperdix manipurensis, Faun. Brit. India, Birds, Vol. IV, p. 122.

Native name:—*Lanz-Soibal*, Manipuri.

One of Mr. Hume's most striking discoveries in Manipuri, this pretty quail is very distinct in appearance from all our species. Its plumage is slate colour, mottled with black above and buff below the breast, this colour broken up into large spots with black markings, which form a cross on every feather. The cock has a dark bay face, which at once distinguishes him from the hen. The bill is dark horny, and the legs orange.

In length this species is about seven inches, with a wing a little over three, and a tail of two inches.

Mr. Hume discovered this species himself when in Manipur, and obtained nine specimens (all he saw except two which were lost) after immense labour and two days' beating in an expanse of elephant grass covering broken ground about two miles square. The birds were in two coveys, and those shot were found to have fed upon both seeds and insects. A single bird was shot ten days later in the same district, and there is a specimen in the British Museum said to be from Sikkim. But except for these few specimens, nothing more was known of the Manipur bush quail till 1899, nearly twenty years after Mr. Hume's discovery of the bird, when Captain H. S. Wood, of the Indian Medical Service, presented one to the Indian Museum, and Lieutenant H. H. Turner two others. Captain Wood, who had found the species quite common in Manipur, afterwards wrote an interesting note on it in the Asiatic Society's *Journal* for 1899. He had shot about eighty of these quail, and did not consider them at all uncommon. The native name means "*Trap Quail*," as the Nagas snare numbers of them in nooses after jungle fires. The birds breed in Manipur, and the egg is large in proportion to the size of the bird, and greenish in colour with black and brown patches; unfortunately

Captain Wood's specimens of them got broken in transit. He found the birds hard to see except after the jungle fires from February to April, as they kept to dense cover, and even after a fire their dark colour made them hard to see on the burnt grass; they were always found close to water. The coveys kept very close when running, and Captain Wood has bagged as many as four at a shot.

The bird is thus pretty well known now, and what is chiefly wanted are birds in young plumage and a well authenticated set of the eggs, which would appear from the description above given to differ from those of the common painted bush quail as much as does the plumage of the parents.

The mountain quail, the last of the Indian *Phasianidæ* which I have to deal with, is still in the same cloud of mystery which enshrouded the Manipur bird till so recently; but as the little Manipuri has been brought to light, we may hope that the same will happen with the present bird.

THE MOUNTAIN QUAIL.

Ophrysia superciliosa, Blanford, Faun. Brit. India, Birds, Vol. IV., p. 105.

The Mountain quail—so called, for it is the least quail—like of all these little birds—is rather larger than the common grey quail, with a decidedly long tail for a bird of the kind, this appendage being fully as long as or longer than any ordinary partridge's, although all but covered above and below by the long tail coverts. The general feathering is also of a long type, but the wings are decidedly short, and the colouring will at once distinguish the bird from any other of the family. The cock and hen, though neither is brilliantly coloured, are absolutely unlike each other, the former being slate-grey, tinged with olive above, and with black edgings to the sides of the feathers, a black head streaked with white, and black under tail-coverts spotted with white; while the latter is brown spotted with black centres to the feathers and the face a sort of pinkish grey.

Remnants of the young plumage on some specimens in the British Museum seem to show that both sexes when young have a garb of closely mottled black, brown and buff, so that they might easily be passed over as of no particular account if the comparatively large tail were not noticed.

The bill is red, bright coral in the male and dusky in the female, and the legs are dull red. In a pair kept in England the bill and legs were yellow. The length is about ten inches, with the tail three, the wing being only three and-a-half, and the shank one.

The mountain quail was described in 1846 by J. E. Gray from living specimens in the fine collection of the Earl of Derby at Knowsley Hall, and he gave the locality as "India" with a query. Nothing more was heard of it till 1865, when Kenneth Mackinnon shot a pair in November, in a hollow between Budraj and Benog,

behind Mussoorie, at about 6,000 feet elevation. Again in November, but two years later, at least one party established themselves at Jerepani, and remained till the summer of 1868; and five specimens were procured. Then, in December 1876, Major G. Carwithen got one bird on the eastern slopes of Sher-ka-danda, close to Naini Tal, at an elevation of 7,000 feet. No specimens have turned up since. It seems to be a migratory bird, arriving in winter, although its small wings look ill-adapted for a journey of any length. It goes in single pairs or coveys, and keeps close to cover in grass jungle or brushwood, being almost impossible to flush without a dog. Its flight is heavy, slow, and short; its food, grass seeds. The call is a shrill whistle. Anyone coming across these birds again should do his best to secure a living pair or two, and either breed from them himself—which could probably be done in the hills in a well-grassed run—or send them Home to the London Zoological Gardens or down to the Calcutta Gardens. In this way eggs might be obtained, whereas we are likely to wait a long time for them if we look to the discovery of a nest in the wild state in the case of such a rare and erratic bird as this one appears to be.

VI.—EXTRACTS, NOTES, AND QUERIES.

The New Hope for the West.

PROGRESS IN THE IRRIGATION AND FOREST RESERVE MOVEMENTS

BY GIFFORD PINCHOT, Forester of the United States Department of Agriculture.

The first immigrants, and the trappers and fur-traders who preceded them, found a vast, strange, formidable region west of the Mississippi, which had its place in the Eastern geographies as the Great American Desert. In early days the journey across it, in the course of which whole companies of immigrants perished, was a matter of six months, and often entailed the most deadly hardships. To-day the West is no longer strange or formidable, the hardships are gone, and the Desert itself has faded from the map and from the minds of men. We have learned its uses.

As the successive waves of immigrants swept westward over the great desolation to the promised land beyond, they left pools of settlement here and there, some permanent, some destined to dry up and disappear before seasons of scanty rainfall or the new knowledge of better land elsewhere. The early settlers could pick and choose; there was comfortable land for all, and it was only a question of finding the best. But with the progress of settlement the best and then the good land was taken up; and the home-makers on the edge of the cultivable belts, and especially the women, suffered the severest trials in the process of ascertaining the fact that they could not succeed—trials of which

little knowledge has ever gone abroad. Except as the farming area is from time to time pushed forward into the arid region by new methods of cultivation or by the discovery of new grains and forage-plants better adapted to dry climates, the chances for the home-maker, otherwise than through irrigation, have been slender for years, and now they are almost wholly exhausted. The story of the struggle on the edge of the arid belt is a record of heart-breaking disappointment, and of failure for causes utterly beyond individual control. But when failure by the old methods was made certain, there came the knowledge of a better way.

"What do you do for water when it doesn't rain?" said a returned Californian ranchman to a farmer in his old home. "I wait until it does," replied his friend. "Well, I don't have to wait," said the Californian; "I carry my water in ditches, not in clouds, and I make it rain with my hoe whenever I want to."

As the irrigation idea took form and spread, the Western people, aided to some extent by federal grants of land, began to build irrigation works and to reclaim the desert. These private enterprises brought about the existence of many prosperous communities of irrigation farmers, but they seldom or never paid either interest or profit to their promoters. One enterprise of this kind created in less than twenty years, at Phœnix in Arizona, a community with taxable property to the value of over ten million dollars, without paying well enough in money to yield the original investors a cent of interest on their investment. But the limit of such development was quickly reached. What could not be done by private enterprise the nation must undertake. Steadily, therefore, but with the slowness of all great new conceptions, the idea of national irrigation grew toward a place in the national consciousness.

Long before there had come into being the knowledge of what the great West is, a movement kindred to irrigation had started into life on the Atlantic coast. The early settlers there had brought with them from Europe an inherited tendency to protect the forests. This passing survival was frequently expressed in legislation, but it was quick to disappear under the stress of frontier life. The extent of American forests, too, began to be realized, and little was heard of forest preservation from the close of the eighteenth century until after the Civil War. The war had been followed by a vast expansion of railroad-building, and that in turn by the development of our marvelously efficient systems of cutting, manufacturing, and distributing lumber. With better transportation the real attack upon the forests began, and following it came tardy efforts for their protection. Among the first results was the organization of a small scientific division of Washington to give information upon forest matters, and later, in 1891, the making of the first federal forest reserve by proclamation of President Harrison. Here was the point of departure for actual growth in national forestry.

The waves of settlement which overspread the level West broke against the bases of the wooded mountains, dashed over them in a spray of explorers, hunters, and prospectors for mineral, and retired, leaving them unsubmerged. These rocky islands in the sea of present and potential homes became the forest reserves.

At first the forest reserves were made for the general object of preserving the forests, and without specific relation to the great problems for which later they were to provide the only solution. Now they are seen to stand at the center of the public land policy of the nation, for out of them come the wood, the water, and the grass which are indispensable for the founding of homes.

The first reserves, made by President Harrison, attracted little general attention. They were followed, however, by the creation of additional reserves to the amount of more than twenty-one million acres by President Cleveland on February 22nd, 1897. This action, taken at the recommendation of a Committee of the National Academy of Sciences, was of peculiar value. It reserved great areas, the protection of which is absolutely essential to the well-being of the West, it gave the forest reserves a place in the public mind, and it laid a broad foundation for future development. Under President McKinley other reserves were created, but as yet no adequate form of management or even protection had been supplied by Congress.

When Congress met on the first Monday in December, 1901, national irrigation was still a hope, and the forest policy of the nation was still unformed. The two movements were still separate and independent, and their relation to the rest of the public land policy was by no means clear. Upon this situation came President Roosevelt's first message to Congress. In it he set the reach and meaning and the essential unity of the two movements in their true light before the nation.

"The fundamental idea of forestry is the perpetuation of forests by use. Forest protection is not an end of itself; it is a means to increase and sustain the resources of our country and the industries which depend upon them. The preservation of our forests is an imperative business necessity.

"The wise administration of the forest reserves will be no less helpful to the interests which depend on water than to those which depend on wood and grass. The water-supply itself depends upon the forest. In the arid region it is water, not land, which measures production. . . . The forest and water problems are perhaps the most vital internal questions of the United States.

"The forests alone cannot, however, fully regulate and conserve the waters of the arid region. Great storage works are necessary to equalize the flow of streams and to save the flood-waters. . . . These irrigation works should be built by the National Government."

Such support from the administration gave the Reclamation Act a new standing in Congress, and the President's personal

influence brought about its amendment in important particulars, to the hindrance of land speculation, and to the advantage of the actual settler. The Act was signed June 17th, 1902, and work under it began at once.

The passage of the National Reclamation Act marked a new era for the West. Its effect upon actual settlement may not unfairly be compared to that of the Homestead Law, signed by President Lincoln in 1862. It devotes the proceeds from the disposal of public lands to the construction of irrigation works by the National Government, and provides that the cost of these works shall be repaid by the settlers who take up the land reclaimed. What it will eventually mean I scarcely dare to predict, but some of its immediate results are obvious. In Southern California, if we count the urban and rural populations together, one and one half acres of irrigated land are required to support one person, and it is probably reasonable to expect that this area will ultimately be reduced to a single acre. But if two acres are required to support one person, the expenditure of the twenty million dollars already in the reclamation fund will in the end make homes for half a million people, the average cost of reclamation being about twenty dollars an acre. After the first expenditure the money will be repaid by the settlers, will return to the Treasury, and will then be available again for repeated use until the irrigation of all reclaimable land is achieved.

Because of the attention directed to forestry and irrigation, a new conception of public land questions, or rather of the public land question as a single problem, has been coming rapidly forward, and the vital importance of it to the nation as a whole is growing into full recognition. We are beginning to see the interdependence of its various parts, such as irrigation, forestry, grazing on the public lands, and the general problem of the best use of every part of the public domain; and the knowledge is becoming a principle of action, with the conception of permanent settlement at its base. President Roosevelt's second message contained this definite recommendation:

"So far as they are available for agriculture and to whatever extent they may be reclaimed under the national irrigation law, the remaining public lands should be held rigidly for the home-uilder, the settler who lives on his land, and for no one else."

In March 1903, in an address before the Society of American Foresters, the President announced a principle which stands at the foundation of every phase of the public land policy of his administration, and especially of his policy in forestry and irrigation:

"And now, first and foremost, you can never afford to forget for one moment what is the object of our forest policy. This object is not to preserve the forests because they are beautiful, though that is good in itself, nor because they are refuges for the wild creatures of the wilderness, though that, too, is good in

itself; but the primary object of our forest policy as of the land policy of the United States, is the making of prosperous homes. It is part of the traditional policy of home-making of our country. Every other consideration comes as secondary."

Speaking of the forest policy of the Government, in the same address he said:

"And you are going to be able to make that policy permanently the policy of the country only in so far as you are able to make the people at large, and, above all, the people concretely interested in the results in the different localities, appreciative of what it means. . . . Keep in mind the fact that in a government such as ours it is out of the question to impose a policy like this from without. The policy, as a permanent policy, can come only from the intelligent conviction of the people themselves that it is wise and useful; nay, indispensable."

The progress of forestry hangs upon practical conceptions such as this. Use must be the test by which the forester tries himself, for by it his work will inevitably be tried.

The test of utility has given the forest movement and the forest policy alike new strength and new acceptance. The misunderstanding of their objects and uses, which has always been the chief local obstacle to the making of forest reserves, necessarily yields before the argument of use, which implies also that no lands will be permanently reserved which can serve the people better in any other way. Forest reserves were never so popular as they are to-day, because they were never so well understood. For this result the President's Western trip in the spring of 1903, during which he constantly advocated forest preservation for economic reasons, is largely responsible.

During the three years of President Roosevelt's administration, and thanks chiefly to his support, forestry and irrigation have made unexpected and unprecedented gains in public estimation. These gains appear especially in the respect of men practically affected, and in the progress and efficiency of Government work. A general increase in public interest in the "preservation of forests by wise use," which is forestry, accompanies the awakening of irrigators and lumbermen; and Congress shows the effect of it in greater friendliness and increased appropriations. With Congress, as well as with the lumbermen, forestry has become a live question.

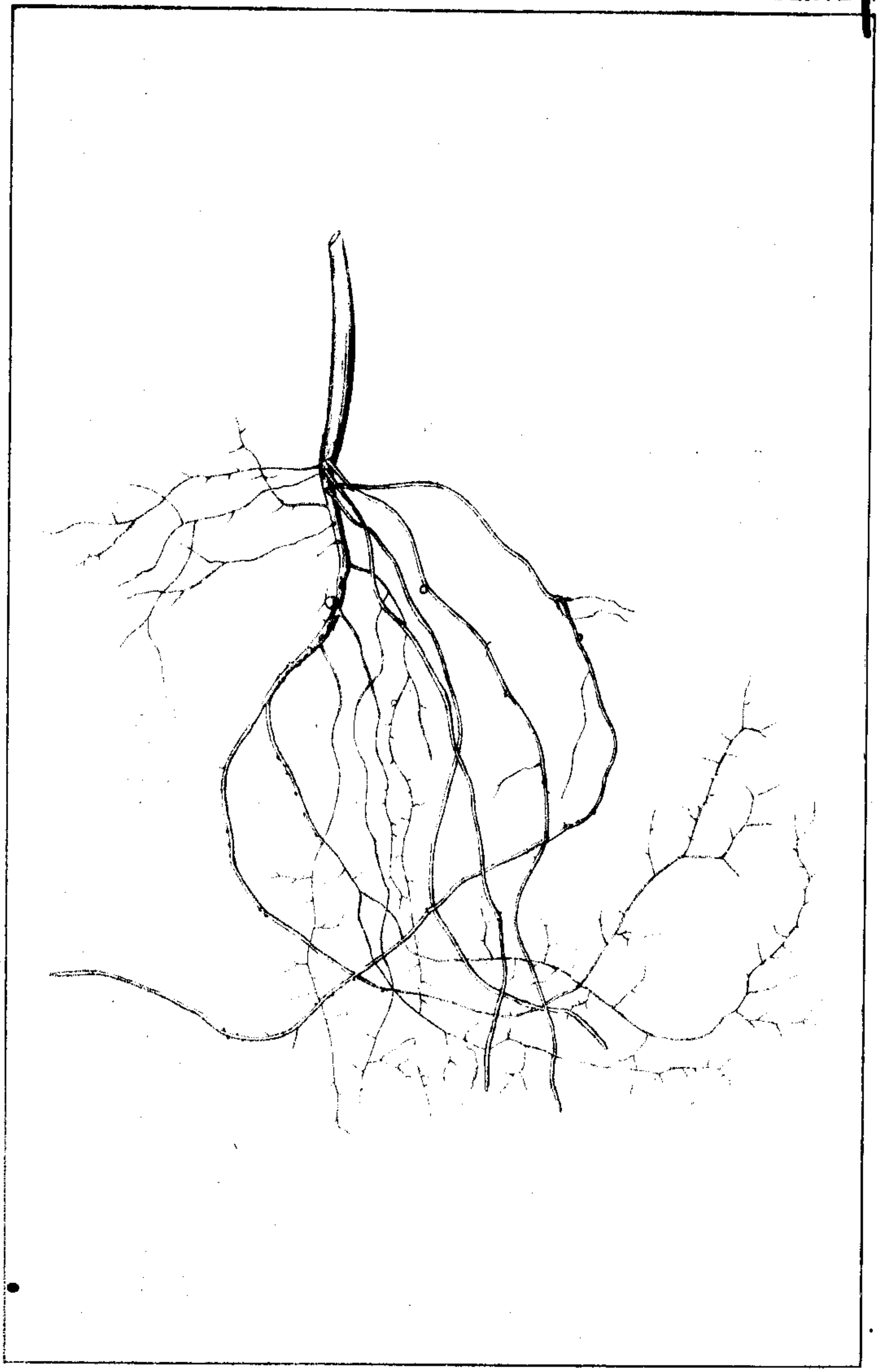
National irrigation is assured, and with it the development of agriculture in its highest and most intensive form, that of the irrigated farm. Intensive cultivation leads to dense population, and that in turn to better means of communication, and to a better and more active social and intellectual life than is possible when homes are scattered and meetings difficult. Fed by the waters from the forest reserves, a new West is springing into the perpetual desert sunshine from lands once altogether worthless.

It is true, however, that far more remains to be done than has yet been accomplished. The execution of the great policy of national irrigation has but just begun. Its successful completion will require all the steadiness, judgment, and executive power of the Reclamation Service, which has been thoroughly well organized to give the policy effect. The outcome will depend, also, upon the protection of the sources of water-supply by forest reserves, for without such protection national irrigation must fail. The need for such reserves to safeguard and conserve the irrigation interests of the West is most pressing, and other interests feel a similar need. The continued productiveness of the summer ranges in the mountains, now in wide and rapid process of destruction, can be assured only by forest reserves. Both the present and the future supplies of timber over great areas in the Western States depend, not merely upon the reserves, but upon the practical and effective character of their management. There is urgent necessity for a national forest service, to be formed by the Bureau of Forestry from the consolidation of the Government forest work, now scattered among three independent organizations. Yet, in spite of all that remains undone, the work is well begun. Agitation has given place to the beginnings of practical achievement.—*The Century Magazine.*

School of Forestry for Ireland.—The Department of Agricultural and Technical Instruction in Ireland have decided to establish a school of forestry in Ireland, and have purchased the Avondale estate in County Wicklow, which is to be devoted to the purposes of a forestry station.

Java Teak.—Mr. Fraser, our Consul at Java, remarking on the output of Java teak (*Tectona grandis*), says that last year was a most unsatisfactory one. This was principally caused by the scarcity of labour, the large rice crop enabling numbers of the regular wood-cutters to remain in their villages without working until their supply of rice was consumed. The year was also an abnormally wet one, and therefore not in favour of the output, which is estimated at about 3,531,600 cubic feet, as against about 5,650,000 cubic feet in 1902 and 4,944,000 cubic feet in 1901. About 353,000 cubic feet were shipped to South Africa in the form of railway sleepers; the balance was exported as squares, logs, sawn wood, &c., to Europe, chiefly to the Netherlands and the United Kingdom. A few small parcels were shipped to China, and during the last few months of the year regular shipments of from 10,000 to 14,000 cubic feet were made to Bombay. It would appear that British India promises to be a good market for Java teak.

According to the latest official returns, the area of the teak forests in Java at the end of 1900 was 265,175 acres, of which 12,140 acres have been planted by the Netherlands Indian Government, the remainder being of natural growth. The average production of wood per acre may be taken at about 2,825 cubict feet.—*Timber Trades Journal.*



Lith. by S. C. Mondul.

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The Study of Sandal Seedlings.

BY C. A. BARBER, M.A., F.L.S.

IT is gratifying to note that more attention is being paid to the natural history of the sandal. *This is a work which has* been unaccountably neglected by Forest Officers in charge of sandal nurseries and plantations, and, considering the parasitic habit of the plant, it is probably due to this neglect that their efforts have met with so little success in the past.

I see, on looking over recent files of the *Indian Forester*, that a number of papers have appeared on this interesting subject, those especially of Mr. Rama Rao, of the Madras Forest Department, showing what results can be obtained by careful observations without the use of the microscope. I would wish to draw the attention of the Mysore Forest Officers to the need of continued study on these lines if they are to be in a position satisfactorily to deal with the problems in sandalwood cultivation which are coming to the fore because of the disease in their plantations.

It has occurred to me that the following observations on seedlings may be of interest to those who are working at this subject.

From a series of pot-experiments commenced in January of this year the following interim results may be recorded:—

(1) When seeds are grown in pure sand and are suitably watered, they are able to grow for a considerable length of time. A well-developed, much-branched root system is formed. This is largely produced from the stores of nutriment in the seed, which are located after germination in the swollen hypocotyl, the "radish-like" portion found at the junction of stem and root. The root system thus formed is, as stated, much branched, and forms a fine and delicate network. Many of the finer rootlets are covered with short root hairs, although these are usually too minute to be seen by an ordinary hand lens. Certain of them develop small haustoria, also covered with root hairs, as if the plant felt its need of some outside assistance. Some of these haustoria are attached to other roots of the system, but the great majority are quite free. In two cases haustoria were firmly attached to small pebbles, and one had sucked a

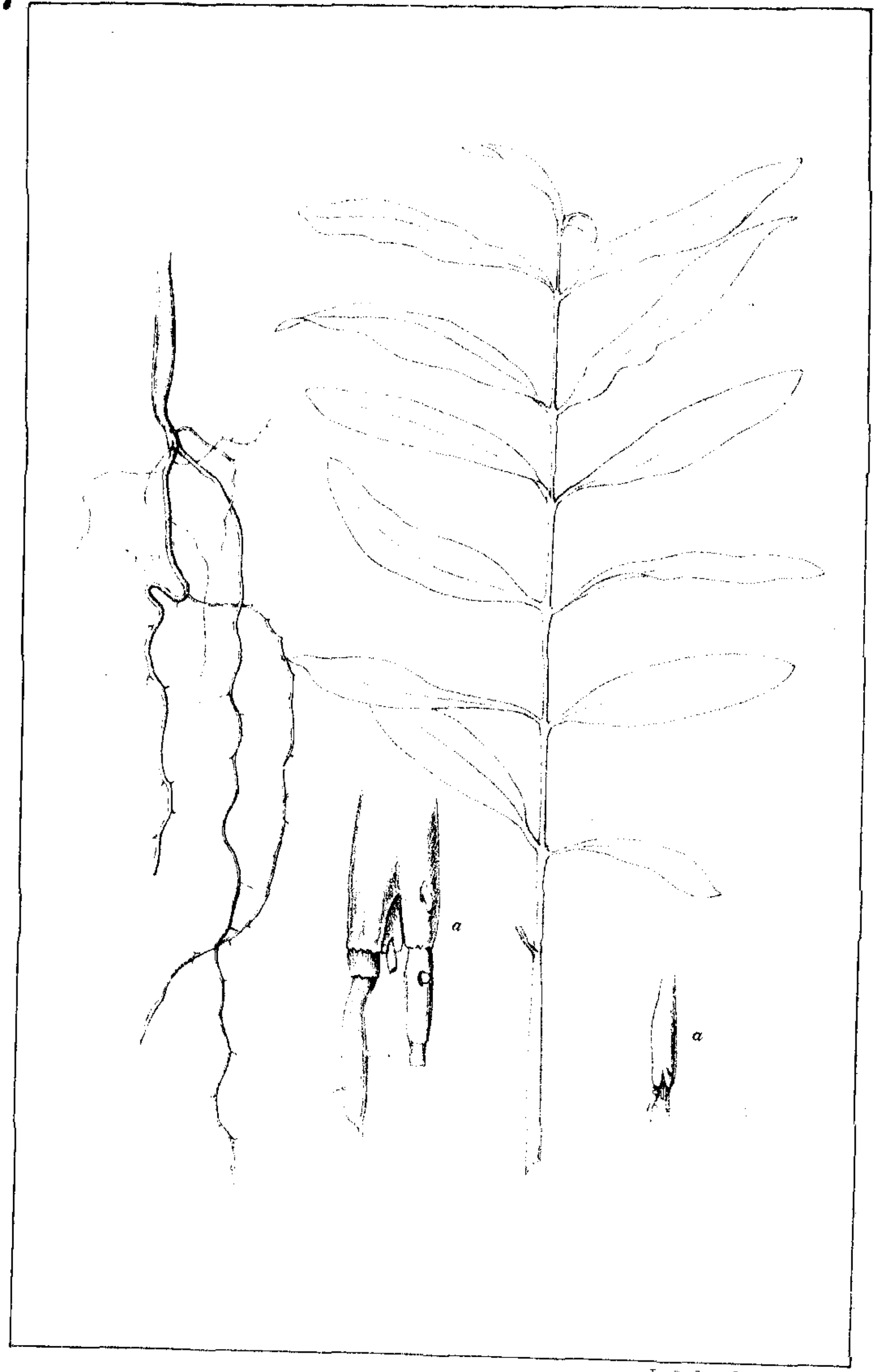
small insect chrysalis dry. From these facts it is evident that the presence, or even nearness, of foreign roots is not necessary for the development of haustoria on sandal roots.

It has also been noticed that when a rootlet commences to form haustoria, it usually does so in many places, so that rows of these are met with on certain roots while others have none. Such roots are specially suited for the study of the early differences between true root branches and haustoria. As is well known, while the latter are formed from the external layers of the rootlet, the lateral roots are formed deep in its tissues and have to push their way out. The difference is at once seen on using a hand lens of moderate power. The young haustoria are conical, frequently flattened in the direction of the long axis of the root, with a broad base; while the rootlets are more or less cylindrical and pointed. The lateral roots are furthermore seen, one and all, to have at their base a minute collar of the tissue thrust aside in their outward progress, and after death this collar is left behind and forms a characteristic scar. This is clearly shown in the figure. Bearing this in mind, it is easy for anyone armed with a hand lens to study the development of haustoria and lateral roots on sandal seedlings. It is also worthy of note that in several rootlets examined dark fungus hyphæ were found in the cortex running parallel with the long axis of the root.

Seedlings grown in pure sand are light green in colour and, although perfectly formed, are evidently not well nourished. After a while the older roots appear to decay, their ends die, and the haustoria already formed become brown and hollow. New whiter roots are then developed higher up the hypocotyl to replace them.

(2) Young plants in a mixture of vegetable mould and sand assume a darker colour and a more healthy appearance. There is little difference in the size of these seedlings and those grown in sand during the first six months, but, on pulling them out and examining the root system, this is seen to be very differently developed. Instead of the fine network of delicate rootlets, there is comparatively little branching. The roots are thicker, reminding one of those found in humus-loving plants, and there are fewer root hairs. These roots seem to be peculiarly subject to the attacks of insect enemies. In some pots every root end was found to have been destroyed as fast as it was formed, and this was apparently the work of a thin, active, long black ant. But even in the absence of insect enemies the roots were unhealthy, the branches quickly dying and leaving scars of characteristic appearance behind them all along the roots, and comparatively few healthy root ends were met with. There was a remarkable absence of haustoria of these roots, although they were very occasionally met with.

The darker green colour and more healthy appearance of these seedlings grown in vegetable mould, as compared with those



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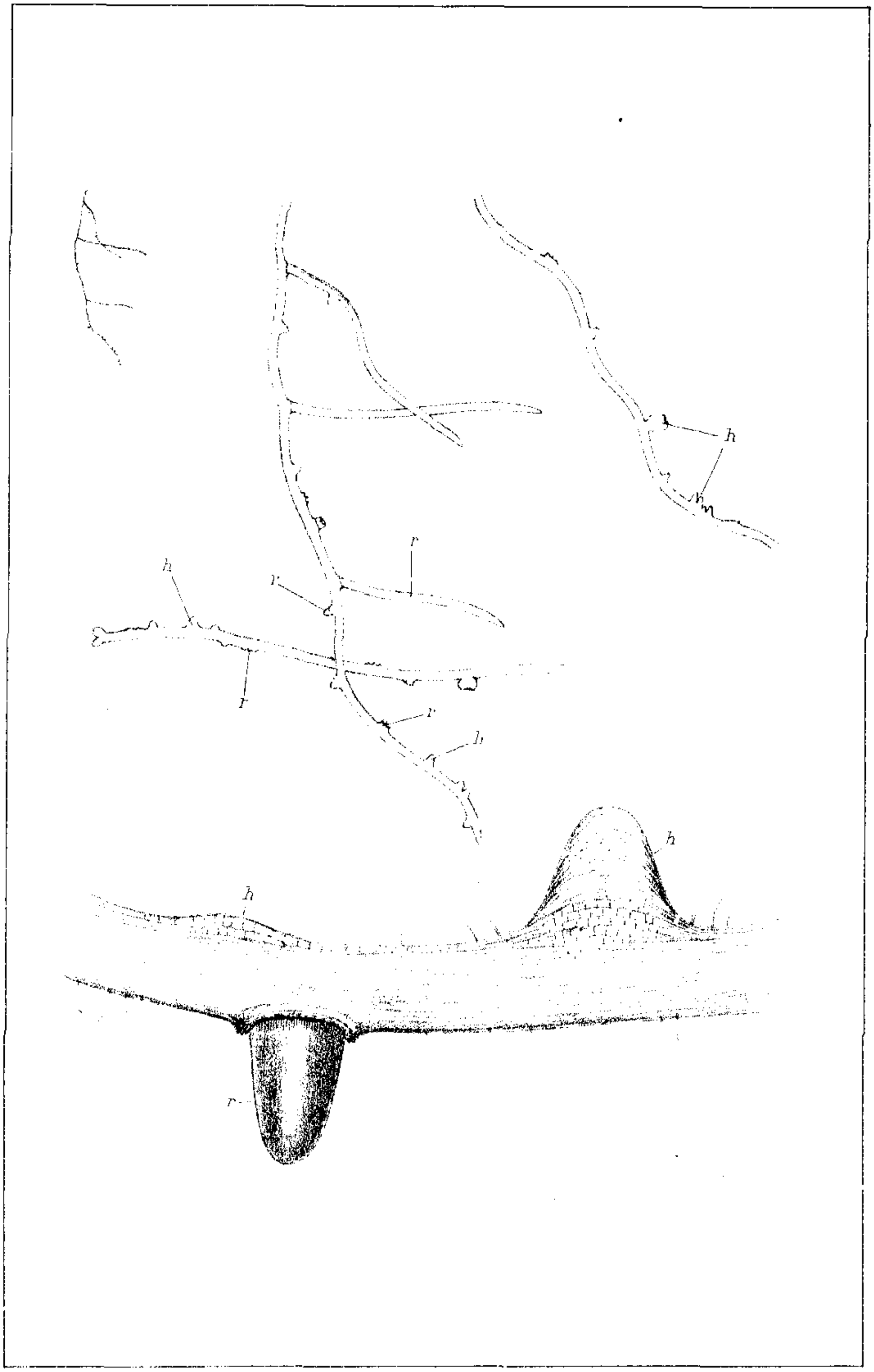

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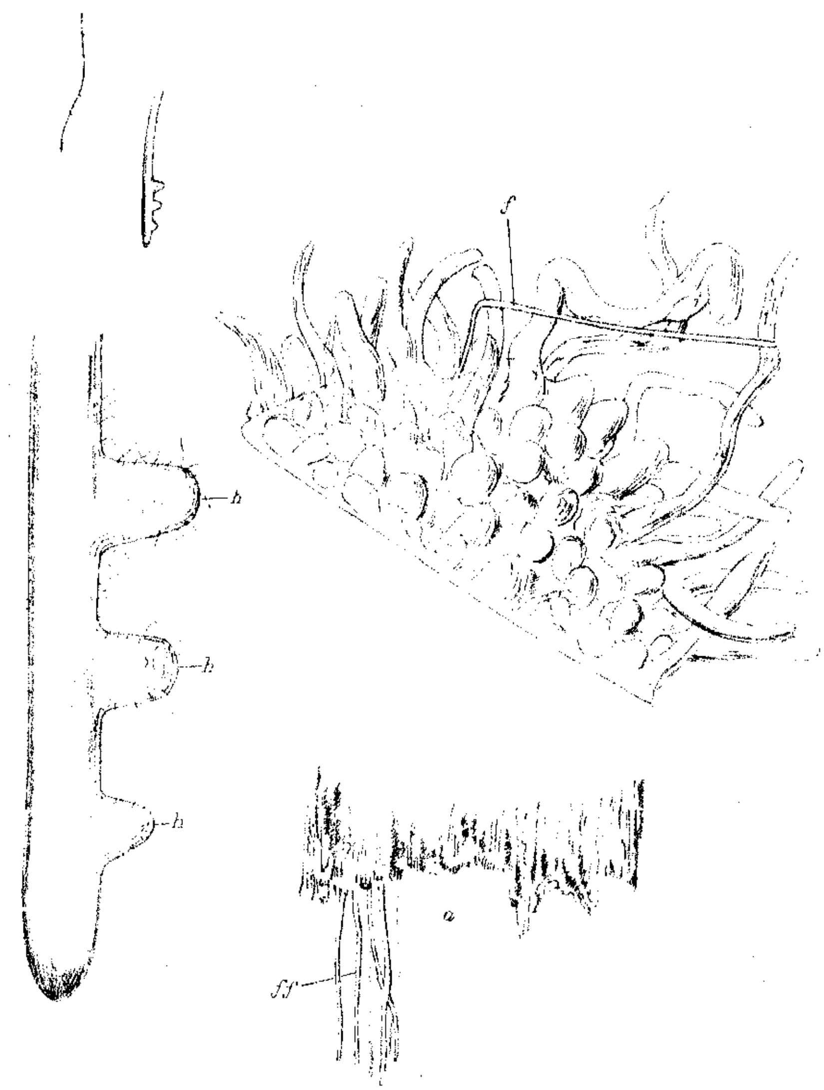

Lith. by S. C. Mondul.

in clean sand, tend to show that, besides living largely on the food stored in the swollen hypocotyl, a certain amount of nutrition was obtained from the rich humus-bearing earth of the pots. But the root system was far from healthy, and it appears doubtful whether the planting of sandal-seed in vegetable mould by itself is a wise practice.

(3) Sandal seedlings grown in pots with well-established garden and other plants already growing in them had a root system differing little from that of the mature plant in nature. They varied greatly in the number of attachments formed, and this seemed to depend on the species of plant in whose company they found themselves. In some cases examined there were no attachments, as, for instance, in a pot full of the roots of livistona, a common ornamental palm. In others, seedlings only a few months old had formed numerous attachments. Such were those planted with Pterospermum Heyneanum, Tecoma stans, Casuarina equisetifolia, &c. It is probable that, although the seedling will attach itself to any root or, on occasion, to the most unlikely substances, the marked preference shown by the mature plant for certain roots reveals itself at an early age. Thus, connections were few and hard to find with several of the Anonaceæ, and all haustoria formed on Artabotrys biglandulosa roots had quickly died. This apparent selection is a matter well worth more extended study while considering the suitability of different plants as hosts in sandal nurseries.

(4) It has been asserted that the roots of sandal seedlings are extremely delicate, and that the greatest care must be exercised in transplanting them. This is, of course, always true of seedlings. But it does not appear to be especially the case with very young sandal. A number of six months old seedlings were re-planted after their roots had been examined and in most cases cut off. They were re-planted in pure sand, and, after a little withering, have recovered themselves and are apparently quite healthy, a month after the experiment was made.

From a consideration of these facts it would seem to be worth while determining whether in starting a sandal plantation the seeds should not be sown in the first instance, say, in tile-pots *with* their future nurses. And it would seem best first to establish the latter and then to sow the sandal on their roots. On transplanting the whole mass of roots would be moved, the sandal would be kept in its place by its attachments, and would probably not suffer at all in the removal.

A careful study of the whole flora of the sandal zones is indicated, and especially the determination of good hosts *(easily propagated)*; it is not likely that the introduction of plants from other classes of forests will be so useful as those which have accustomed themselves for long periods to the same conditions as the sandal.

It is obvious that, without a more sympathetic study of the needs of the sandal and its very peculiar characteristics, attempts at making artificial plantations or conserving those in existence are not likely to meet with much success. And it is hoped that these few facts may be of interest to some of your readers, and perhaps may induce those interested in the propagation of this interesting plant to conduct experiments on these lines. It may be worth while mentioning in concluding that, in order to satisfactorily examine the root system of any plant and preserve the endings intact, it is necessary to take out the whole soil and very gradually wash it away from the root mass. Otherwise the extremely delicate endings and the light attachments will inevitably be broken.

EXPLANATION OF THE PLATES.

Plate I Root system of a sandal seedling, six months old, grown in pure sand. Haustoria are to be seen at intervals, and strong new roots are being developed from the collar.

Plate II Sandal seedling, six months old, grown in vegetation, mould and sand.

(*a*) The root system of a plant, apparently healthy aboveground, which has been attacked by insects.

Plate III Roots of the plant in Plate I magnified to show the differences between lateral roots (r) and haustoria (h).

Plate IV A root-end with haustoria, natural size and magnified, showing the root hairs to be found both on the surface of the roots and on the haustoria. The end of the haustorium is drawn to show the papilla-like form of the epidermal cells and the formation of root hairs.

(*a*) A broken piece of root is shown with hyphæ of a fungus (*ff*) protruding from the torn cortex of the root.

India and the Royal Society.

A passing remark that officials in India did little to further scientific research, partly from want of leisure and opportunity, but chiefly from want of the ability and perseverance without which little headway can be made in this direction, led me to peruse the latest year book of the Royal Society of London.

To use the letters F. R. S. after one's name is to bear the hall-mark of the Scientist, and is a distinction as eagerly sought after as it is difficult to obtain.

The Society was originally founded for improving natural knowledge, and a candidate for election has to be proposed by at least six Fellows, and then subsequently has to undergo the ordeal of the ballot by which the fifteen new Fellows are chosen each year from amongst the candidates who have been proposed for election.

I have not succeeded in ascertaining the exact date of the founding of the Society, but it was in a flourishing condition in the latter portion of the Eighteenth Century, when, in 1780, some of the Fellows who were chemists founded an association, or perhaps more correctly a club, which met fortnightly at a coffee-house for the discussion of chemical subjects. Eight years later other Fellows, who were interested in Botany, founded the Linnean

Society, and later on other independent societies sprang up, each for the purpose of cultivating more especially one distinct branch of natural knowledge. Large and influential as some of those societies now are, they are all descended from one common stock, the Royal Society of London.

At present there are 465 Fellows, of whom 26 have a more or less intimate connection with India. Of these the following are less closely connected with the country:—

Sir J. Hooker (1847), Lord Ripon (1860), Sir W. T. Thiselton Dyer (1880), Sir Mountstuart Grant-Duff (1881), Sir H. H. Howorth (1893), and Lord Curzon (1898).

Hooker wrote the flora of British India; Lord Ripon was Governor-General of and, subsequently, also Secretary of State for, India.

Thiselton Dyer is the Director of Kew Gardens and a botanist of world-wide reputation. Grant-Duff, a former Governor of Madras, wrote *The Elgin Speeches* and *Notes of an Indian Journey*; and Howorth is known for his literary and archæological attainments. He is the author of *A History of the Mongols* and *The History of Chenghiz Khan and his Ancestors*. Lord Curzon has made a name as a traveller, and is the author of *Problems of the Far East*, *Russia in Central Asia*, and *Persia and the Persian Question*, the standard book on Persia. As Viceroy he is of course at present very intimately associated with India.

The remaining Fellows were or are all closely connected with India, and were admitted to the Royal Society almost entirely on account of the work done by them whilst resident in India.

The Indian Medical Service claims four Fellows:—Sir J. Fayer (1877), Cunningham (1889), Ross (1901), and Alcock (1901). Fayer was Surgeon-General, and devoted much time to snakes and their poisons. Cunningham was a Professor in the Calcutta University, and an expert in Physiology. Ross is well known in connection with malaria and the mosquito; while Alcock is Superintendent of the Indian Museum, and the Indian authority on Crustacea and Fishes.

The Survey of India numbers Thuillier (1869), a Governor and former Surveyor-General; Herschell (1871), an R. E. and late Deputy Superintendent of the Great Trigonometrical Survey of India; Hennessey (1875), one of the earliest Deputy Surveyors-General; and Burrard, the present Superintendent of the Great Trigonometrical Survey of India, whose recent researches into the cause of the declination of the pendulum in Northern India have excited the greatest interest.

Brandis (1875), Gamble (1899), and Schlich (1901) represent the Forest Service. Brandis organised the Forest Service in India, was its first Inspector-General, is a botanist of great repute, and author of *The Forest Flora of North-West and Central India*. Gamble was Conservator of Forests and Director of the Imperial Forest School, is a well-known botanist, and author of *A Manual of*

Indian Timbers and *A Monograph of the Bambuseæ*. Schlich was Inspector-General of Forests, and is Professor of Forestry at Cooper's Hill; a forester pure and simple, he is responsible to a great extent for the gradual awakening at Home of the public to the importance of forestry to the future of Great Britain.

Strachey (1854), Tennant (1869), and Baird (1885), of the Royal Engineers, were all well-known names in India, and did much for the country through their great engineering and irrigation works.

The Geological Department is represented by Blanford (1874) and Holland (1904). The former was head of the Department, and, on retiring, devoted himself chiefly to zoology, in which he has made a name. Amongst his chief zoological works are the *Mammalia* and *Birds* in *The Fauna of British India*, of which latter work he is Editor.

Pedler (1892) and Bourne (1895) belong to the Educational Department, the former having been a Professor of Chemistry in Calcutta, and the latter a Professor of Biology in Madras, and well known for his researches on Indian earth-worms.

John Eliot (1895) was Meteorological Reporter to the Government of India, and wrote a series of *Memoirs* dealing with storms in India and cyclones in Indian Seas.

Sir George King (1887), as Superintendent of the Royal Botanic Gardens, Calcutta, was eminent as an Indian Botanist and Quinologist, and rendered much valuable assistance to the cause of Botany and Natural History in India.

The list it is true is not a long one, but it suffices to show that amidst the pressure of official life in India there are more than a few who have, not without success, devoted much of their time, often their spare time, to the cause of scientific research.

R. McIntosh.

Deodar Plantations and Aspect.

By *B. O. Coventry, F.C.H.*

The following observations made during a tour in Jaunsar, N.-W. Himalayas, United Provinces, in May 1903, with regard to the effect of aspect on the deodar plantations at Bodyar, elevation about 8,000 feet, may be of practical interest:—

Year of planting.	Present age.	Aspect.	Soil covering.	Method of plantation work.	General appearance of plants.	Height of deodar.
1898 ...	7	S.-W.	Grass only ...	Deodar planted about 5′ × 5′	The plants are yellow and unhealthy ...	2′ 6″
1897 ...	8	S.-W.	Grass and shrubs.	Ditto	The plants are fairly healthy, due to the protection given to them by the shrubs.	3′ 10″
1896 ...	9	S.-E.	Grass and a few isolated trees.	Deodar planted alternately with sown patches of blue pine.	The deodar plants have nearly all died, but a few have survived where they have shelter from other trees already existing. Blue pine has succeeded well, and the plants are 8′ high.	3′ 6″
1896 ...	9	S.-W.	Grass with shrubs sparsely scattered.	Ditto	The deodar have all survived, but are yellow and unhealthy; here and there where they have shelter from shrubs they are of a good healthy colour.	3′ 6″
1896 ...	9	W.	Grass and shrubs.	Deodar planted 5′ × 5′	The plants are in excellent condition, of good colour, and vigorous growth. They seem to be benefited by side shelter, but are dwarfed where shade from shrubs is excessive.	5′ 0″
1892 ...	13	S.-S.-W.	Grass only ...	Ditto	The plants are yellow and unhealthy ...	5′ 6″
1892 ... (Asmari)	11	S.-W.	Grass and shrubs.	Deodar and blue pine sown in mixture.	On exposed places the deodar has failed, but under protection of shrubs it has succeeded. Blue pine has succeeded everywhere.	3′ 0″
1892 ... (Asmari)	11	N.-E.	Ditto	Ditto	Both species have succeeded, but the blue pine has attained a height of about 12′ and is suppressing the deodar. The deodar are still healthy and only require more light by cutting back the blue pine.	4′ 0″
1881 ...	24	N.-E.	...	Deodar planted 5′ × 5′.	The plants are in excellent condition.	20′ 0″

Note.—The plants put out into the forest were two years old, which accounts for the present age being two years more than the plantation.

The elevation in all cases is about 8,000 feet above sea level. The soil is much the same in all the plantations, being naturally somewhat better on the cooler aspects, but is good enough in all the plantations. Gradient is steep, about 30°-40°.

The above notes show that on the hot southern aspects the plantations were not successful unless the transplants were planted under the shelter of some shrub or tree already existing on the ground. The plantation of 1896 was particularly instructive, as planting was carried out at the same time on different aspects: on the south-east aspect the deodar plants had died with the exception of a few plants which had the protection of trees or shrubs; a little further on, after turning to a south-west aspect with shelter from trees and shrubs, the deodar plants had survived, but were mostly yellow, except where they had ample shelter, in which case they were healthy and growing well; further on still, on a west aspect, the deodar plants were all thriving, and of a good healthy colour.

The plantation of 1892 at Asmari was also a very interesting one: sowings were made of mixed deodar and blue pine seed. On the south-west aspect the success is indifferent: the blue pine has succeeded, but the deodar has failed, except in a few cases where the young plants have grown under the shelter of trees or shrubs already existing on the ground. On the north-east aspect both the blue pine and deodar have succeeded, but the latter is being suppressed by the blue pine (the deodar having a height of about 4 feet and the blue pine about 12 feet). Another portion of this Asmari plantation consists of a dense growth of indigofera coppice with deodar plants well distributed below it. The Forest Guard informed me that this area was treated by cutting back the indigofera close to the ground and sowing deodar seed. The indigofera has outgrown the deodar and retarded its growth; but at the same time there appears every probability that the deodar will free itself without artificial assistance. This is interesting because it tends to show that indigofera coppice of the same age as deodar will give the necessary shelter without suppressing the deodar altogether.

From the above notes we may draw the practical conclusion that if bare grassy slopes with hot southern aspects are to be stocked with deodar it is necessary to, first of all, bring on to the ground some other species to act as nurses, under whose shelter deodar can afterwards be introduced.

The best manner of introducing nurses requires further experiment. It does not appear to give satisfactory results to sow blue pine seed simultaneously with the planting of deodar nor with the sowing of deodar, as in both these cases the deodar failed. If blue pine is to be used as a nurse, it will probably be necessary to give it several years' start before introducing deodar, but in this case care will be required in preventing the suppression of deodar. To avoid this difficulty it may be more advisable to use shrubs, such as indigofera, desmodium, deutzia, rubus, rosa, &c., as nurses; but this is mere speculation, and only careful and systematic experiments will give the necessary information. Such experiments as these would be most satisfactorily carried

out by a special research bureau, the necessity of which is constantly being brought forward.

In conclusion it may be added that in all the plantations referred *to above the transplants used were "basket plants,"* so that the question of bad planting as a cause of failure need not be considered, and we may fairly assume that the differences in the success of the plantations were due mainly to the different aspects, the other conditions of locality being much the same in all cases. It must be borne in mind that the different aspects simply mean different exposures to heat and light, and that the above remarks only apply to localities similar to that of Bodyar, namely, elevations of about 8,000 feet on the outer hills of the Himalayas.

Pioneers of Indian Forestry.

CAPTAIN FORSYTH AND THE HIGHLANDS OF CENTRAL INDIA.

(*Continued from p.* 499.)

As we have already seen, the Pachmari plateau was fixed upon to form the centre of the forest operations to be undertaken by Forsyth, and a Forest Lodge, the pioneer of the bright little station which now forms the summer headquarters of the Central Provinces Administration, was to be erected in this beautiful spot—the heart of the country of the Gonds and Korkus—the plateau sacred to the deity Siva. A conception of awe and mystery had always been associated with the lofty peaks which culminate in this plateau, and embosomed among them lies one of the most sacred shrines of the god, to which at least one pilgrimage is necessary in the life of every devout Hindu. But, excepting at the appointed season for this pilgrimage, no dweller of the plains would venture, at the time of which I am writing, to set his foot on the holy soil of Mahadeo's hills. This was the cause of considerable trouble to Forsyth, and he mentions that, as he approached its neighbourhood, gloomy looks began to gather on the faces of his followers, whose fears had been acted upon by the conversation of the people they had met. The usual excuses were put forward—the road was represented as impassable from natural difficulties, and it was guarded by wild beasts, goblins, and fell disease. *Tempora mutantur!* The apprehensions of his men did not daunt Forsyth, and he reached the platea, which he describes as bearing the aspect of a fine English park, the plain being dotted with giant trees of harrá (*Terminalia Chebula*), jámun (*Eugenia jambulana*), and the mango. Arriving in the evening, our traveller saw, through the vista of the trees, three great isolated peaks appear, glowing red and fiery in the setting sun against a purple background. The centre one of the three was Mahadeo, deep in the bowels of which lies the shrine of the god himself, being supported

on the left by Chauradeo, and on the right by Dhupgarh, the highest peak of these Central Indian highlands.

In his first ramble over the plateau Forsyth mentions an interesting fact. His dogs put up and he shot a fine specimen of the solitary or wood snipe (*Gallinago nemoricola*), which he says is rare in Central India, he having only met with it once in the Mandla district. He considered that this was the bird which stood for the woodcock in the stories told of the latter's occurrence in the Central Provinces; for, although he had hunted for this bird at every likely spot in the hills, he had never met it. It would be interesting if sportsmen in these parts would let us know whether subsequent researches have borne out this contention.

On Forsyth's arrival on the plateau he found two small settlements of Korkus thereon, one consisting of about 30 houses at Pachmari itself, with a Thakur as the head of it. The area of the plateau is about 12 square miles, and the scene from it is thus described:—"To the south, as far as the eye can see, lie range upon range of forest-covered hills, tumbled in wild confusion. To the east a long line of rampart-like cliffs marks the southern face of the Mahadeo Range, the deep red of their sandstone formation contrasting finely with the intense green of the bamboo vegetation out of which they rise. Here and there they shoot into peaks of bare red rock, many of which have a peculiar and almost fantastic appearance, owing to the irregular weathering of their material—beds of coarse sandstone horizontally streaked by darker bands of hard, vitrified, ferruginous earth. Looking across this wall of rock to the north-east a long perspective of forest-covered hills is seen, the nearer ones seeming to be part of the Pachmari plateau, though really separated from it by an enormous rift in the rock, the further ranges sinking gradually in elevation, till, faint and blue in the far distance, gleams the level plain of the Nerbudda valley. Standing on the eastern edge of the plateau, again, the observer hangs over a shere descent of 2,000 feet of rock, leading beyond in long, green slopes down to a flat and forest-covered valley. Its width may be six or seven miles, and beyond it is seen another range of hills rising in a long, yellow, grass-covered slope, dotted with the black boulders and ending in the scarped tops that mark the trap formation. That is the plateau of Motur, with which the general continuation of the Satpura Range again commences (after the break in it occasioned by the Mahadeo group). On this side the forest that clothes the valley and the nearest slopes present a very dark green and yet brilliant colouring, which will be noted as differing from the vegetation in any other direction. This is the sal forest which forms the singular outlier far to the west of the line which otherwise limits the range of that tree in Central India. It fills this valley of the Denwa almost to the exclusion of other vegetation, and, creeping up the ravines, has occupied also the south-eastern portion of the plateau itself." Such was the country

in which Forsyth had come to work; and he was met, as many another Forest Officer has been met, with the obstruction and delays so often experienced by men in a similar situation in India. The Thakurs, probably foreseeing that this was the first step towards the opening out of the solitudes to Western civilization and progress, resented the appearance of this Pioneer of the Forest Department, and placed every obstacle in the way of the erection of the Forest Lodge, and his difficulties might have proved well nigh insuperable had he not been favoured by two things. Owing to the failure of the previous harvest there was very considerable scarcity amongst the wild tribes. Their system of cultivation was the one then appertaining to all the forest tribes of India, that of jhuming. They possessed no cattle or ploughs to break up the soil with, and therefore left untilled such rich areas as the fine open plateau of Pachmari, preferring the shifting method which consisted in felling an area of forest, burning it over, and raising two or three crops in the ashes of the burnt trees, and then moving on to a fresh area. This, with a few pumpkins and creeping beans reared about the houses, were all they troubled to grow. They eked out their means of subsistence by adding, whenever possible, animal flesh. Animals of all sorts would pay visits to the jhumed areas, and by means of traps and the village *shikari* they managed to procure their destruction at times. In addition, they used to hold several grand drives in the forest yearly; and of their fondness for this form of sport Forsyth, who was himself an enthusiastic sportsman, soon took advantage to gain the goodwill of the tribes and get workers. Their system of cultivation (if such a word can be used for one of the most ruinous forms of agriculture which man ever devised or put in force) was, of course, of the most precarious character. The holding off of rain for a few weeks after the seed was sown, or when the ear was forming, meant ruin to the whole, and the owner was then compelled to depend for his subsistence entirely upon the wild fruits, roots, and products of the forest. Nature has been very bountiful in these forests in her supply of food for their wild denizens, and it is to be hoped that the march of Western civilization will not lead them to despise and so forget these products of Nature, upon which scarce four decades ago their forefathers so often had to almost entirely depend for their living in years of failure of the crops. Many species of tree and bush ripen a wholesome and palatable fruit in their season, and these were supplemented by roots. The mohwa flower (already alluded to), the plum of the ebony (*Diospyrus melanoxylon*), the fruit of the wild mango, the berries of the chironji (*Buchanania latifolia*), and the ber (*Zizyphus jujuba*), the seeds of the sal, the bean of the giant Bauhinia creeper, &c., are eaten; also a species of wild arrowroot and a sort of wild yam are dug up. The rare seeding of the bamboo was a godsend to them, and from the way Forsyth

writes of this it would appear that he had seen one, and a successful one. The tribes have a proverb that this portends a failure of the crops, and this was certainly the case in 1900, a year of famine, when the bamboo flowered over 1,200 square miles in the Chanda district. The eagerly-looked-for bamboo seed was never garnered in, however, for a bug* appeared on the scene and prevented the ripening of the seed. Forsyth noted that, in addition to the large annual drives in the forests the tribes also captured many small fish in the mountain streams, chiefly by poisoning the pools with various vegetable substances, a species of strychnos being one of them. Even at that period the hillmen who lived in the neighbourhood of the plains went to cut the crops of the plainsmen after cutting their own dhyas, but the genuine hillmen of the interior would have nothing to do with such work, and often suffered severely in times such as those at which Forsyth appeared amongst them. As I have said, our Pioneer was a sportsman, and he soon saw a method of bringing round the tribes, probably the only method by which he could have won them over. He sent down to the nearest market and purchased a store of wheat and millet, and issued shooting invitations to all the Gonds and Korkus chiefs of the neighbourhood with their followers, and every available man in the hills was sent for to beat. A store of grain was despatched to the site selected to feed them all, and one of the Pachmari grog-shops was taken down bodily. Many a Forest officer of the present day has doubtless often found that the way to get his work done, and done cheerfully, is by following Forsyth's plan. The great drive came off. A number of animals were killed, and a heavy dinner was followed by the monotonous singing and dancing to which these tribes are addicted, and which, with the help of the tom-toms and shrill bamboo flute, flanked by the mohwa spirit and pipe, is usually kept up the live-long night through. Two days after the great orgie parties of the hunters began to drop in, and the work on the Forest Lodge commenced and went on intermittently, for regular work was not to be expected from these hill tribes (one of the difficulties so often facing the man who has to deal with these forest tribes and quite unrealized by those who have not been in contact with these men), to its completion.

After seeing the Lodge well under weigh Forsyth visited the sal forest in the Delakari valley, to the east of Pachmari, one of the few forests in that part of the country which had escaped destruction at the hands of the timber speculator and dhya cutter, it being inaccessible to the former and unsuitable from its level character and the size of the trees to the operations of the latter. The trees of this forest bore every appearance of being fully mature, but the largest averaged no more than six or eight feet in

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* *Ochrophara montana* Distant. *Vide* Department Notes on Insects affecting Forestry, No. 1, p. 123.

girth, whilst most of them, subsequently cut down, were found to be almost useless from heart shake and dry rot. A lease of this forest for Government was soon concluded, and a road laid out connecting it with the open country. It was here that our Pioneer shot two does of the 12-tined deer (*Rucuirri duvanallii*), an animal which, like the sal forest in which it lives, had been supposed not to extend to the west of the sal belt in the Mandla District. He was not lucky enough to shoot a stag, but saw a frontlet in possession of a native *shikari* and heard of a fine stag being shot by a Railway Engineer; they were evidently not numerous however. He also found that the red jungle-fowl of North-Eastern India (*G.* Gallus) inhabited this sal forest and the hills around it, though otherwise not found west of the Mandla sal belt, *G. sonnerati*, properly belonging to Western and Southern India, being also met with in the Pachmari hills. Two species of spur fowl, *Galloperdix spadicea* and *G. lunulata*, the chikara gazelle, and the little four-horned antelope also frequented this part of the hills. Tigers rarely appeared on the plateau, and lions were equally scarce. Bison were, of course, plentiful on the hills and in the valleys.

Having seen the Forest Lodge in a fair way to completion, Forsyth started off on the first of many long journeys of exploration among the forests of the Seoni, Chindwara, and Betul Districts. These are situated upon the great central tableland, with an elevation of 2,000 feet, which consists of a great overflow of basalt, the only interruptions being the Mahadeo sandstone block and a few isolated granite peaks. This great volcanic region, which is by no means level, having been denuded by the larger streams to a depth of 1,000 feet, may be termed the region of the teak tree in Central India. The tree does not strictly confine itself to the trap formation, nor is it the only, or even the principal, species. The distinction is, however, marked enough to warrant the inference that there is some link of connection between them. Whilst Forsyth found that the teak was scattered more or less all over this region, he noted that the principal forests were found clinging to the skirts of the higher ranges rising from the general area of the plateau, the more extensive level portions having been long cleared of jungle for cultivation purposes. For a long way round these settlements the forests had been hacked down into mere scrub for the common requirements of timber and fuel of the people. The outer slopes of the plateau, towards the lower plains, had been swept long before of all valuable teak, probably, owing to their sterile nature, at no time a large quantity. Even in the higher and more secluded tracts where he found forests of teak still remaining the number of mature and well-grown trees had been reduced to a very small proportion of the whole, so small that it was considered that in few places were there more remaining than would suffice to reproduce the forests naturally in a period of 50—100 years. He

found the trees growing everywhere in patches in mixture, the chief other hard woods being the Saj, Pentaptera, Bijasal (Pterocarpus), Dhaora (Canocarpus), Anjan (Hardwickia). He states that the mature teak attained a girth of from 10 to 15 ft. with a bole of 70 ft. to 80 ft. to the crown. "Perfect specimens," he wrote, "*are rare, the majority of such trees as remain having* suffered injury in the sapling stage from fire or axe so as to permanently contort their form." Forests containing any great numbers of tolerably good trees were extremely few, the trees having been indiscriminately hacked down for centuries. At the same time, owing to its coppicing power, our Pioneer observed that the teak was present in the state chiefly required by the population, *i.e.*, as poles, for this coppice attained a height of 25′—30′ in five years with a girth of 1′ or 2′, and these were all that the people required for their house-building, in which large timber had no place. "It was thus perhaps scarcely very surprising that when we suddenly demanded from the forests a large and permanent supply of big timber for railway purposes we found that they could not supply it."

Forsyth has some criticisms well worthy of consideration. "Our treatment of this question of the teak forests is a good example of the difficulties in Indian administration which arise from inaccurate information on the real requirements of the country and the obstacles in the way of reconciling the conditions of a low and almost stationary stage of society with 19th Century progress. In the cry for great timbers for our railways we totally forgot, or reglected, this demand of the masses of the population for small timber for their houses and many other purposes. We shut up every acre of teak-producing country we could, and referred them *to inferior woods, all the best species, besides teak, having been* reserved along with it." Noting that the pollarded teak will not grow straight and large, but having grown to a certain size (the size required by the natives) it then decays and twists into every variety of tortuous shapes, Forsyth continues: "What we should have done was to reserve the best forests for timber purposes proper and apply to the rest—the vastly greater part of them—only such measures as would ensure the best and quickest production of coppice wood for the requirements of the people. It has been said that they should do as European nations do—convert large trees to smaller scantlings by the saw, as more timber is obtained from a forest of large trees. Theoretically it is true enough, and in the distant future it may be realised. But in the meantime the people have not the capital nor do the large trees exist." Forsyth had not received the professional training of a forest officer, but we cannot but think that he was born with an intuitive perception of the principles of true forest conservancy, which must make the needs of the population, present and future, their first consideration, and entirely subordinate to annual surpluses.

Perhaps the commonest species of tree in this vast teak region is the Salei (*Boswellia thurifera*), with a soft, spongy wood useless for timber and which had also been rejected for firewood. Forsyth states that it produces an excellent charcoal and is adapted for most ordinary purposes of fuel, and he points to this as "another mistake in our Indian Forestry. Undoubtedly this and other soft wood trees should have been forced into common use by the people as fuel long ago, instead of giving way to their outcry for hard woods and bamboos, the use of which should be confined to certain special requirements." These great desolate tracts of *Boswellia* forest greatly impressed the explorer, and he remarked that should some of the properties of the tree assume commercial importance the supply would be practically unlimited, since stakes stuck in the ground in the rainy season rapidly take root and shoot into trees. He was acquainted with some of its economic characters. It yields a fragrant gum resin which is burnt as incense in Hindu temples. This was long thought to be the Olibanum of the Ancients employed for a similar purpose. Its Sanscrit name *labana* still closely resembles that of the Ancients, and Forsyth was not inclined to consider, as suggested by others, that our knowledge of the ancient commerce of the country sufficed to exclude India from the list of countries which contributed the frankincense of the Boswellia to the fanes of heathen gods. He was also of opinion that the soft woody filre of the tree would be adapted for the manufacture of coarse paper or cloth. The country about the Tapti River furnished a specimen of this Boswellia forest; and very stiff such a country is to get about in.

On the subject of forest fires the following remarks are of some interest:—"The grass being universal in the jungles of these provinces is undoubtedly beneficial in a great variety of ways. It allows and assists by the manure of the ashes a crop of green and tender grass shoots to appear for the vast herds of cattle which form the great part of the wealth of the people in the neighbourhood of jungle tracts. It kills multitudes of noxious insects and snakes. It probably prevents much malaria that would arise from the vegetation if gradually allowed to decay. It destroys much of the harbour for wild beasts. And the ashes no doubt form a valuable ingredient in the deposits of soil carried down by the drainage of these hills to lower regions, and in the cultivable crust forming in these uplands themselves. It has been held by some that these fires are very injurious to the growth of saplings of teak and other valuable trees. But it is an undoubted fact that teak seed will germinate and produce seedlings when the grass has been fired better than when it has not; and it is not well established that much permanent injury is afterwards done to the seedlings." It will probably be of interest to Burma foresters, now engaged in considering this question,

to read an opinion on the subject written over four decades ago.

Forsyth gives rather a graphic picture of what the exploration of these forests meant. "The labour of exploring such forests during the hot season when alone they are sufficiently open and free from malaria is immense—day after day toiling over those interminable basaltic ridges, where many marches have to be made without meeting an inhabitant, without often a single green tree for shelter, and dependent for water on a few stagnant pools puddled up by the feet of wild animals. This was what often fell to the lot of the forest officers of those early days. I doubt if many of them would have gone on with the task but for the love of sport and adventure which probably led to their original selection of a jungle life, and there is not one of them whose health did not, after a few years, give way under the combined assaults of malaria and a fiery sun." There are few of us perhaps even at the present day to whose minds on reading these lines vivid memory pictures of such days as Forsyth describes will not arise.

Amongst the animals found in the teak region the bison, sambhar, spotted deer, barking deer, and four-horned antelope are mentioned. The hog deer did not, he thought, occur so far to the south-west as the trap country.

Having explored the teak area Forsyth next turned his attention to the sal forests of the tract assigned to him, commencing from Mandla. Above this latter place the valley of the Narbada opens out into a wide upland country, the main river between this and Jubbulpore here radiating like the figures of a hand and draining the rainfall of an extensive triangular plateau, the Mandla district. These converging valleys, known as the Banjar, Halon, Phen, Khormer and Amarkantak (chief source of the Narbada), respectively, rise in elevation towards the south, where they terminate in a transverse range of hills, the Maykat Range, which overlooks to the south the flat country of Chhattisgarh. This tract contains within its outer circle of hills an area of not less than 7,000 square miles, much of it of a broken and unculturable character. The Mykat Range and the radiating spurs which separate the plateau are mostly clothed with sal forest which almost monopolises the parts where it grows. The saj (*Terminalia tomentosa*) alone grows in any quantity with it. Some of the hills are covered with the ordinary species of forest trees of other parts where the geological formation is not the one favoured by the sal. The valleys are fairly open and free of all undergrowth and dotted here and there by hills and islands of sal. This country has a much less arid character than that previously explored, as the sal tree, being practically an evergreen, the forests have always a beautifully cool, fresh appearance. Our Pioneer also found the climate of the uplands much more temperate, the thermometer showing a mean of 77° during the hot season, but ranging from abont 50° to 100° in night and day temperatures.

Except close to Mandla, the country was scarcely populated at all when Forsyth visited the town, at one time the seat of one of the Gond Rajput ruling dynasties, the remains of whose forts still crown, in crumbling decay, the top of many a forest-covered mound. *The Gonds were here a very poor and subdued race,* practically serfs in the hands of the money-lenders who speculated in the produce they raised. Far superior to them were the still utterly unreclaimed forest Bygas, an aboriginal race inhabiting the hills of the Mykat Range and its spurs. The same tribe extends over a vast range of forest-covered country to the west of Mandla under the name of Bhumias. These Bygas are very black, with an upright slim wiry frame, and show less of the negretto type of feature than any other of these wild tribes. They wear only a small strip of cloth with, in full dress, a coarse cotton sheet worn cross-wise over the chest, and carry coal black hair in a long tangled mass. Their arms consist of a bow and arrrow, in which they are very expert, and a small keen little axe. Dhya cultivation was the only form of agriculture they practised, and their habitations were neat bamboo wicker work erections pitched far up on the hill side. Of a true forest stock and full of courage, the Byga knew not fear and would attack any forest animal. In the pursuit of game they used poisoned arrows, merely cutting out the discoloured portion of the flesh round the arrow wound of the animal killed, holding that the rest is wholesome food.

Forsyth found that the Byga was the most terrible enemy to the forests existing anywhere in his tract of country. Thousands of square miles of sal forest had been clean destroyed by them in the progress of the dhya cultivation, the ground being subsequently occupied with a dense scrub of low sal coppice springing from the stumps. In addition the largest trees had been everywhere girdled to allow the gum resin of the sal (the "dammer" of commerce) to exude. This ringing of the sal trees was one of the first things prohibited in the Government areas, but continued for long afterwards in the Native States, and is probably still a practise in such of these latter as have been left by the contractor with any trees worth ringing. The dammer together with lac dye was collected, in exchange for salt, beads and arrow poison, by traders who annually visited the hills for this purpose. It was the one and only commercial transaction of the Byga in the whole year.

To its remarkable reproductive power Forsyth attributed the *fact that the sal tree was not exterminated* in these tracts by its relentless enemy. "The inborn destructiveness," he remarks, "of these jungle people to trees is certainly very extraordinary; even where it is clearly against their own interest, they cannot apparently refrain from doing wanton injury. A Gond or a Byga passing along a pathway will almost certainly, and apparently unconsciously, drop his axe from the shoulder on any young sapling that *may be growing by his side, and almost everywhere* young trees so situated will be found cut half through in this manner." A

great patience and several generations are necessary before this kind of thing will be entirely stopped. Besides lac the cocoons of the wild tusser silk-moth (*Antheraea mylitta*) were collected in great number for sale to the caste of silk spinners who lived by this business in the villages in the plains. The insect lived chiefly on the *saj*, and the trees of this species grown near the villages were pollarded to provide sufficient fresh foliage for the larvæ. In addition to this scanty exportation of the minor produce of the forests the only other economic use to which they were put in the years before Forsyth's arrival on the scene was the splendid grazing they afforded for countless herds of cattle annually brought to them during the hot season from great distances in the open country on both sides. Fine grass and abundance of shade and water made this one of the finest grazing countries in all India, and Forsyth notes that the amount of wealth which thus actually seemed to depend on its continuance as a waste appeared very great. At first sight, he says, some hesitation might be felt at the prospect of these great grazing grounds being reclaimed for cultivation when it is considered how all-essential to the life of a country like India is the breeding of large stocks of oxen for draught purposes. Certainly any measure which would be likely to endanger the existing supply of plough cattle would be highly objectionable. But I think, he continues, that no apprehension of the sort need be entertained from the probable reclamation of such tracts as the Mandla savannahs. Sufficient forest land must always remain in the higher regions to furnish the green bite at the end of the hot season, which is all that is necessary to tide the herds over the most trying part of the year, and for the rest, the people will soon learn to do as other countries have done, and as other parts of India even have done, namely, to devote a part of the cultivated area to the raising of green pasture for the cattle by irrigation. This fine natural pasture is no doubt a great advantage; but it is not at all indispensable even in India. When Forsyth penned these lines he had had a very considerable experience first as a Forest Officer and then as a Settlement Officer, but even after this he did not fully realise that this particular question was to prove one of the greatest difficulties of the Department, and that the education of the people in this direction would be a terribly slow business.

The resources of the country in iron and other mineral wealth had never been fully examined in those days, the gold-washing out of the sands of the streams scarcely repaying the labour.

Forsyth had one or two suggestions to make with reference to the utilisation of these great waste tracts. He thought that it would pay to import some of the teeming millions of the coast districts to furnish labourers for reclaiming the waste instead of transporting them to the West Indies, the Mauritius and

other distant countries as had already been done in his time. Another suggestion was that cattle breeding would furnish most promising openings as the absence of labour and roads would be of less consequence.

The highlands of Central India may perhaps properly be said to terminate where the steep southern force of the Mykal Range, trending away to the north-east, culminates in the high bluff promontory of Amarkantak. From this height of 4,000 feet the eye embraces a view of three-fourths of a circle uninterrupted by anything but the blue haze of the distance. To the east and north, 2,000 feet below, appears a flat sea of greenery, broken here and there by an isolated peak. In the faint distance beyond rises another wall of rock visible only on a clear day as a faint violet-coloured shade across the sky. The green plain is a vast forest of sal unbroken by tillage and scarcely inhabited by man, in the time of which I am writing, and after his work in the Mandla district was finished, Forsyth started on a six months' exploration of this vast region of sal forest. Over all this country the wild buffalo roamed, and in the forests north and east of Amarkantak were then found herds of wild elephants, which descended at the ripening of the crops of Chhattisgarh to the skirts of the forest, doing immense damage and forming a serious obstacle to the cultivation of the country. To penetrate to their haunts, ascertain their number and propose means for their destruction was another of the explorer's objects on this expedition. At the end of January he descended the Rajadhar Pass from the Mandla district and marched across the Chhattisgarh plain, where antelope, duck, snipe, etc., afforded plenty of occupation for the sportsman. Here he met the Chief Commissioner's camp, and thence proceeded to the eastern and southern forests. Whilst he never allowed himself to linger for sport, he says that the herds of buffalo were in some parts of this country so numerous that it would have been almost impossible to avoid encountering them.

The party sailed down the Mahanadi to Sambalpur in two days and a night after leaving the high road between Raipur and this station, the boat consisting of a long canoe hollowed out of a sal tree. "After resting a while at this most secluded of stations (they get their supplies from Calcutta, several hundreds of miles away, on men's heads, and a convoy had just been trampled up by wild elephants before we arrived) we started for the Garhjat States, where the next month was spent in unremitting toil among their rugged hills." He was here among the Khond aborigines, and he expresses a wonder that they could ever have been confounded with the Central Indian Gond, the former being of a much lower type. He returned from this trip with most of his followers severely ill of fever contracted in the close forests "where water is so scarce and bad at this time of year (April) that we rose, like river gods, from our daily bath hung with the green slime of the fetid pools from which our supplies were drawn.'

Marching northward he entered the valley of the Jonk River, a tributary of the Mahanadi, and found that it it was mostly devastated by dhya cultivation. Leaving it he proceeded along the Mahanadi and its tributary the Arpa to the civil station of Bilaspur, which he reached on 28th April. It was here that the arrangements were made for his expedition to the elephant haunts of the great sal forest to the north of this station. It was reported to be scarcely inhabited except by a few utterly savage Bhumias, and it was certain that no supplies of any sort would be procurable. Such was the then land-locked condition of this fertile country that as much wheat, gram and rice as were required were purchased at the rate of about 100 lbs. for a shilling. Forsyth was very nearly prevented from seeing the elephant country at the outset, as at the end of the first two marches he went down with a fever which, at the end of two more, declared itself as small-pox. So determined was he to see this country if possible that he refused to return to the station, and instead got carried to the top of a conical hill, crowned by a fortress, called Laäfagarh, which had an elevation of about 2,450 ft. Here he stayed till the 15th May, and rapidly recovered from the attack, taking, as he says, no medicine save seidlitz powders. As soon as he could move at all he descended the hill and marched on an elephant for Matin. Here our Pioneer had a relapse, but when in a few days news was brought in of a fine tusker being within half a mile of the camp, he managed to climb on to his pony 'to at least see him,' as he puts it. Government had prohibited the shooting of cow and young elephants, but not the old tuskers. But for a stupid *contretemps* Forsyth would have bagged this tusker, which was a well-known customer and a rogue of the worst description. Losing this animal was a great disappointment to him, as neither he nor his soldier companion ever had another chance at one. Marching due north from Matin to Amarkantak the country was so level and the prospect so circumscribed by the never-ending array of great gray sal stems that it was very easy to lose one's way. The small population which existed subsisted entirely on what they shot with their bows and arrows, and the roots and fruits ofthe jungle; they had no cultivation. They collected the 'dammer' from the sal to barter for the few necessaries they required of the trader. Forsyth found that owing to this scantiness in the population the sal forest had escaped much of the devastation it had suffered where the tribe was more numerous and when it was cut down for dhya cultivation. Only the oldest trees which, if not cut down, would soon become useless from heart shake and dry rot were ringed for the dammer. This great tract was remarkable for the absence in it of animal life in the hot season. It being quite level, with a light porous soil in the summer, no water is found on the surface although, the soil is full of moisture. The footmarks of a few four-horned antelopes, the voice of the cuckoo in the early morning, and rare glimpses of some

hornbill or woodpecker were all the animal life Forsyth saw whilst marching though this tract. He found it very difficult to ascertain distances, the Bhumias' 'coss' being a very variable quatity, the basis being the distance a yell can be heard from a hill top. Thus their long measure becomes—

2 yells	...	... = 1 daab (or "bittock")
2 "*bittocks*"	...	... = *1 coss*
12 coss	...	... = 1 day's march

which seemed, he says, to be about 30 miles!

So far as they could learn, an area of about 1,200 square miles was occupied by herds of wild elephants, whose number was estimated to range from 200 to 300. These undoubtedly did very severe damage to the crops of the neighbourhood, and for many years the annual tribute of the Thakurs whose possessions they disturbed had been remitted on this account. After a good deal of reporting and correspondence the Government of India was induced to send down a Keddah establishment, which attacked these herds during the years 1865--67.

On the 1st June Forsyth climbed the steep ascent leading to Amarkantak from the east. He was still very ill and weak and had to march on an elephant, and tempted by the coolness of this elevated region to stay and rest; but the clouds banking upon the horizon threatened the commencement of the rains, and he determined to march straight to Jubbulpore by the direct road to the north of the Narbada. "That frightful march still lives in my dreams. In the first ten days we kept to the elevated country south of the river, which we then crossed. The country to the north is an utterly bare sheet of black basalt without a field or tree....The sun was at its hottest. Day after day we toiled along in the fierce heat pitching in a burning plain, without a particle of shade, and I really thought that before we reached Jubbulpore on the 16th July I should have had to sit down decently and give up the ghost. I had marched close upon 1,000 miles in changes of camp alone since I left the station in the preceding January. How much more should be added for our explorations it would not be easy to say." The Forest Pioneers were a fine lot of men, and we, their successors, cannot but feel proud to follow in the footsteps of such as they, amongst whom Forsyth was one of the brightest examples. That was to be his last march as a Forest Officer. Broken in health he went home on furlough soon after, and on his return was made Settlement Officer of Nimar. In both branches his work excelled; and in taking leave of him we cannot do better perhaps than quote one last passage from his book—that book which is so much a part of himself.

"The Government of India have been fully awakened to the necessity of watching over the important part of their trust

which resides in the forest regions. Even now it is doubtful whether the clearances already effected have not seriously deteriorated the rainfall of the country, as they certainly have much impaired the supply of useful timber, and the example of many countries, ancient and modern, is a warning against rash interference with the life-giving forests of hilly regions, where rivers are born. The scientific forester must now take the place of the explorer; and the Government have taken the proper course in seeing that all newly-appointed forest officers shall in future go through a course of instruction in the advanced schools of Germany and France. The danger is lest a too purely professional view of forest questions be allowed to exclude considerations bearing powerfully on the general economy of the masses of the people and particularly of the hill tribes; and lest cut and dried theories, based on the example of moist temperate regions, be applied without sufficient caution to very different conditions of tropical forests ....The wisdom of the administrator must always be joined to the technical skill of the forester to secure the best results."

A Contribution to the *Forest Flora* of the Jubbulpore Division, C. P.

By R. S. Hole, F. C. H., F. L. S., F. E. S.

(*Continued from p.* 514.)

Anacardiaceae.

(73) Odina wodier. Vern. *gunja*.
F. B. I. II. 29. Br. 123.
Fl. March. Young foliage May-June.

(74) Semecarpus anacardium. Vern. *Bhilāwan*. *Bhilwān*. *Kohakā* (Gondi).

F. B. I. II. 30. Br. 124.
Fruit ripens April.
Coppices well, shoots eight years old and 20 feet in height having been measured.

(75) Mangifera indica. Vern. *Am*. *Markā* (Gondi).

The mango.
F. B. I. II. 13. Br. 125.
Fl. January—March. Fruit ripens May-June.

(76) BUCHANANIA LATIFOLIA. Vern. { *Chār.* / *Sareka* (Gondi).

F. B. I. II. 23. Br. 127.

Fl. January-February. Fruit ripens April-May.

Young foliage May-June.

The fruit has a delicious flavour and is most refreshing on a hot May day. The kernel of the fruit (*chironji*) is also largely eaten.

MORINGEAE.

(77) MORINGA PTERYGOSPERMA. Vern. *munga.*

F. B. I. II. 45. Br. 129.

Fl. cold season.

Cultivated near villages.

LEGUMINOSAE.

(78) INDIGOFERA PULCHELLA. Vern. { *Birhol* / *Jilra.* / *Jirīla.* } (Gondi.)

F. B. I. II. 101 Br. 136.

Fl. January. Fruit hot season.

(79) SESBANIA AEGYPTIACA. Vern. *Jaīt.*

F. B. I. II. 114., Br. 137.

Commonly planted near villages and in gardens.

(80) S. CANNABINA.

F. B. I. II. 115.

A shrubby plant, often gregarious in water on the edges of tanks and reaching a height of 10 to 15 ft. Fruit cold season.

(81) S. ACULEATA.

F. B. I. II. 114.

A tall shrubby plant, a weed of damp fields. Flower and fruit found January.

(82) MILLETIA AURICULATA. Vern. *guhalāri.*

F. B. I. II. 108. Br. 138.

Common in *sal* forests.

Fl. August. Fruit February.

Bark used for poisoning fish.

(83) ABRUS PRECATORIUS. Vern. *gūnchi.*

F. B. I. II. 175. Br. 139.

Fruit ripens cold season.

(84) ERYTHRINA SUBEROSA. Vern. *haruwa.*

F. B. I. II. 189., Br. 140.

There appear to be two distinct varieties of this tree in this locality. The one which is commonly seen near villages and on good deep soil has a very corky bark

pale yellowish in colour, with deep cracks. This variety retains its leaves until January-February. The other variety is commonly found wild in the forests, on dry rocky hills, and has a distinctly different appearance. Its bark is far less corky, reddish-brown, yellowish or greenish in colour with longitudinal white cracks. The leaves are shed early in autumn, about October, and the young foliage does not appear till next rains.

Both varieties flower March-April, when they are leafless, and fruit ripens May-June, but the corky variety is usually somewhat later than the other.

I have unfortunately been unable to get complete specimens of both varieties, and am unable to say whether the differences noticed are merely caused by a change in the locality or not, but the trees are certainly very distinct in general appearance.

(85) BUTEA FRONDOSA. Vern. { *chiola*, *mur* (Gondi).

F. B. I. II. 194. Br. 142.
Fl. March. Young foliage April.
Fruit ripens April-May.
Lac is here largely cultivated on this tree. The fibre from the roots is very widely used. The young shoots and leaves are rarely eaten except by buffaloes, and not extensively by them, unless no other fodder is available. The tree is common on black soil, but also thrives and is gregarious upon the low rocky hills of metamorphic rock, which are very characteristic of the central portion of the Jubbulpore district.

(86) B. SUPERBA. Vern. { *bhador chiola*, *bhouria chiola*, *bhadrosi*.

F. B. I. II. 195 Br. 143.
Flowers March. The masses of silvery, tomentose green pods, covering the bare branches of tall deciduous tree, are a noticeable feature in these forests in April-May.

(87) FLEMINGIA STROBILIFERA. Var *bracteata*.
F. B. I. II. 227., Br. 143.
Common in *sal* forest.
Fruit cold season.

(88) F. LINEATA —
F. B. I. II 228. Br. 143.
Small shrub of hedgerows.
Fl. cold season. Fruit February-March.

(89) PUERARIB TUBEROSA. Vern. *bilaikand.*
F. B. I. II. 197., Br. 141.
I have seen tubers believed to be this species, but I have personally never found the plant.

(90) ONGEINIA DALBERGIOIDES. Vern. { *tinas.* *tinsa.*
F. B. I. II. 161. Br. 146.
Fl. March. Fruit April-May before the leaves.
Reproduces well from rootsuckers and is occasionally found practically pure on old abandoned fields. Also coppices well. On 13th June 1901 I measured tinas coppice shoots of 6 ft. in height, on an area felled on the 3rd March 1901. The young leaves and shoots are greedily eaten by deer and cattle.

(91) SPATHOLOBUS ROXBURGHII.—
F. B. I. II. 193., Br. 143.
Fruit found December.

(92) DALBERGIA LATIFOLIA. Vern. { *shisham.* *shishawan.* *sisōn.*
F. B. I. II. 231. Br. 148.
Not common, and usually of small size

(93) D. SISSOO. Vern. *Sissu.*
F. B. I. II. 231., Br. 149.
Planted at Jubbulpore and a few other places.

(94) D. PANICULATA. Vern. { *dhoben.* *pānsi.*
F. B. I. II. 236 Br. 150.
Fruit cold season.

(95) D. LANCEOLARIA.—
F. B. I. II. 235. Br. 151
Flowers in April and young foliage appears about the same time. Fruit ripens January. Not common.

(96) D. VOLUBILIS. Vern. *birach.*
F. B. I. II. 235. Br. 152.
Fl. February. In shady forests.

(97) PTEROCARPUS MARSUPIUM. Vern. *bija.*
F. B. I. II. 239. Br. 152.
Young foliage June. Fl. in rains.
Widely distributed but nowhere plentiful.

(98) PONGAMIA GLABRA. Vern. *kanji.*
F. B. I. II. 240 Br. 153.
Young foliage April and flowers shortly afterwards. Fruit ripens following April. Old leaves shed March; commonly planted in avenues.

(99) CÆSALPINIA BONDUCELLA. Vern. *gatāran.*
F. B. I. II. 254. No. 156.
Fl. rains. Fruit ripens February.
Common near villages in hedges.

(100) C. SEPIARIA. Vern. *kirkich.*
F. B. I. II. 256. Br. 156.
Fl. cold season. Common in hedges.

(101) C. PULCHERRIMA. Vern. *newaria ?*
F. B. I. II. 255. Br. 157.
Cultivated near villages.
Fl. cold season.

(102) POINCIANA REGIA. The gold mohur.
F. B. I. II. 260. Br. 157.
Common in gardens.

(103) PARKINSONIA ACULEATA Vern. *dakhani bamura.*
F. B. I. II. 260. Br. 158.
Cultivated in gardens.
Fl. cold season—Fruit February-March.

(104) BAUHINIA MALABARICA. Vern. *amta.*
F. B. I. II. 277. Br. 159.
Fruit found cold season; said to flower April-May.
Leaves are acid.

(105) B. RACEMOSA. Vern. $\left\{\begin{array}{l}\textit{ashto.}\\ \textit{mohala.}\\ \textit{daurera.}\end{array}\right.$
F. B. I. II. 276. Br. 159.
Fruit cold season, sometimes remaining on the tree as late as April.

(106) B. PURPUREA. Vern. *keolar.*
F. B. I. II. 284., Br. 160.
Fl. cold season. The green pod usually bears characteristic splashes of red or purple colour.

(107) B. VARIEGATA. Vern. $\left\{\begin{array}{l}\textit{kachnār.}\\ \textit{mohata.}\end{array}\right.$
F. B. I. II. 284. Br. 160.
Fl. Feb-March before the new foliage. Pods without the red splashes of colour of last species, and ripen April-May.

(108) B. RETUSA. Vern. *thaur.*
F. B. I. II. 279. Br. 161.
Fl. November-December. Not common.

(109) B. VAHLI. Vern. $\left\{\begin{array}{l}\textit{mohalain.}\\ \textit{paur}\text{ (Gondi).}\end{array}\right.$
F. B. I. II. 279. Br. 161.

Fl. April-May, the festoons of white flowers, hanging on the bare branches of the deciduous trees, being then a noticeable feature of these forests. The pods are roasted in the fire and the seeds then eaten. Heaps of empty charred pods which have been thus treated are frequently met with.

(110) TAMARINDUS INDICA. Vern. { *imli.* / *chitta* (Gondi).

F. B. I. II. 273. Br. 163.

Young foliage May and flowers about the same time; fruit ripens following March-April. Commonly planted.

(111) CASSIA FISTULA. Vern. { *jhagaruwa* / *rela.* / *kirwāra.* } (Gondi.)

F. B. I. II. 261. Br. 164.

Flower and young foliage May-June. The tree is then a beautiful spectacle with the dark red-brown and fresh green of the young leaves contrasting with the magnificent racomes of bright yellow flowers. Pods ripen cold season, but often remain on the trees as late as April.

(112) C. SOPHERA. Vern. *bara chakaora.*
etikol.

F. B. I. II. 262.

Large undershrub. Fl. rains; fruit cold season.

The dried stems are used for splitting stone by burning in quarries.

(113) C. TORA. Vern. *chakaora.*

F. B. I. II. 263.

Fl. rains; fruit cold season; common weed of waste places.

(114) C. SIAMEA.

F. B. I. II. 264.

Common in gardens and avenues in Jubbulpore.

Fl. rains.

(115) C. GLANCA.

F. B. I. II. 265.

Planted in gardens.

(116) MUCUNA PRURIENS. Vern. *kiwānch.*

F. B. I. II. 187.

Fl. rains; fruit November—March.

(117) SARACA INDICA.—

F. B. I. II. 271. Br. 166.

Cultivated in gardens. Fl. March.

(118) MIMOSA RUBICAULIS. Vern. { *eil.* / *narisānp* (Gondi.)

F. B. I. II. 291. Br. 172.

Fl. in rains.

(119) ALBIZZIA ODROATISSIMA. Vern. {*bānsa.* / *erma.*}
F. B. I. II. 299. Br. 175.
Young foliage in April. Pods remain on the trees till April. Good clean poles are often seen in dry rocky situations rising above the general level of the low scrubby growth around.

(120) A. PROCERA. Vern. {*gurār.* / *kirangi* (Gondi).}
F. B. I. II. 299. Br. 175.
Common near streams.
New foliage in April. Fruit cold season, pods remaining on trees till April.

(121) A. LEBBEK. Vern. *siris.*
F. B. I. II. 298. Br. 176.
Common in avenues and gardens.
Fl. and young foliage April. Pods ripen cold season and remain on trees till April.

(122) ACACIA FARNESIANA. Vern. {*gandharri.* / *gandhila bamura.*}
F. B. I. II. 292., Br. 180.
Fl. December—February; cultivated near villages.

(123) A. ARABICA. Vern. *bamura.*
F. B. I. II. 293. Br. 180.
On black cotton soil. Common in avenues, hedges and near tanks. Fl. in rains. Fruit ripens April-May.

(124) A. FERRUGINEA. Vern. {*bara khair.* / *garkhair.*}
F. B. I. II. 295. Br. 185.
Only found twice, in the teak area on trap.

(125) A. LENCOPHLOEA. Vern. *reonjha.*
F. B. I. II 294. Br. 184.
Common on black cotton soil.

(126) A. CATECHU. Vern. *khair.*
F. B. I. II. 295., Br. 186.
Fl. and young foliage May-June.

(127) A. CAESIA. Vern. *gurār.*
F. B. I. II. 297. Br. 189.
Fl. April-May. Fruit cold season. Is essentially a strong climber, but can support itself in the open. It, together with the next species, forms a large proportion of the open, scrubby, thorny forest characteristic of the drier portions of the laterite and Vindhyan sandstone areas. In such situations, in the absence of other species on which to climb, the *gurār* is sometimes found standing alone and erect in the open and I have found a small erect tree of this species 15 ft. in height.

(128) A. PENNATA. Vern. *ramna*.
F. B. I. II. 297. Br. 189.
Fl. rains; fruit cold season.
With the last species, is very common on the Vindhyan sandstone and the laterite. It is at once distinguished from *gurār* by the fact that its leaves have an acid taste, its foliage is a paler and more yellowish-green in colour, and its pods are dark-straw-coloured, whereas those of *gurār* are almost black.
In this locality the climbing habit of this species is not very pronounced. It is usually a straggling shrub, or small erect tree. It is often found standing alone in the open, quite erect, and I have measured a small tree of this description 18 ft. in height and 18 in. in girth. The old bark is very like that of *khair*.

(129) A. CONCINNA.
F. B. I. II. 296. Br. 188.
Fl. March. The thick pods ripens December—February. In hedges near villages Not common.

(130) DESMODIUM GANGETICUM.
F. B. I. II. 168. Br. 146.
Under shrub of shady forests.

(131) D. LAXIFLORUM.
F. B. I. II. 164.
Undershrub of shady forests.

(132) D PULCHELLUM.
F. B. I. II. 162. Br. 145.
Common in *sal* forests.

(133) D. GYRANS.
F. B. I. II. 174. Br. 146.
In *sal* forests. Fruit cold season.

(134) CROTALARIA SERICEA. Vern. *bansan*.
F. B. I. II. 75.
Stout undershrub. Fine yellow flowers December-January.

(135) C. JUNCEA. Vern. *san*.
F. B. I. II. 79.
Widely cultivated.

(136) CAJANUS INDICUS. Vern. {*thur*. *arhar*.
F. B. I. II. 217.
Widely cultivated. An attempt was made a few years ago to propagate lac on this plant in the forest villages of this Division, as is done in Assam. The seed lac was tied on the *arhar* plants in October-November, but although the insects swarmed out satisfactorily and began to form incrustations, they perished in all cases before the incrustations had become of any size,

probably owing to the rapid liquefication of the tissues of the *arhar* shoots.

(137) PSORALEA CORYLIFOLIA —
F. B. I. II. 103.
An erect herbaceous plant of hedges, with firm branches. Fl. February.

(138) *TERAMNUS LABIALIS.* —
F. B. I. II. 184.
Slender climber. Fruit cold season.

(139) DOLICHOS LABLAB. Vern. *sem.*
F. B. I. II. 209.
Widely cultivated. Fl. cold season.

(140) ALYSICARPUS RUGOSUS. Var. *Heyneanus.*
F. B. I. II. 159.
Large herbaceous plant of waste places.

(141) ATYLOSIA CRASSA. Vern. *bansem.*
F. B. I. II. 213.
Small twiner. Fl. cold season.

(142) CYLISTA SCARIOSA.—
F. B. I. II. 219.
Fl. cold season.

ROSACEAE.

(143) ROSA INVOLUCRATA.—
F. B. I. II. 365. Br. 199.
Cultivated in gardens.
Fl. March.

(144) ERIOBOTRYA JAPONICA. The Loquat.
F. B. I. II. 372.
Cultivated in gardens.

(145) PRUNUS PERSICA. Vern. *aru.*
The Peach.
F. B. I. II. 313. Br. 191.
Cultivated in gardens.

COMBRETACEAE.

(146) COMBRETUM OVALIFOLIUM. Vern. { *hathisandan.* / *dimarbola.* }
F. B. I. II. 458.
A robust creeper, sometimes covering other trees and shrubs, at others forming thickets by itself on the banks of streams and ravines. Fl. April. Old leaves shed February-March before the appearance of the flowers and turn red before falling.

(147) TERMINALIA BELERICA. Vern. *bahera.*
F. B. I. II. 445. Br. 222.
Fl. April; fruit ripens cold season. Young foliage April-May.
Good, straight, clean poles are often seen in low scrub jungle in dry, rocky situations.

(148) T. CHEBULA. Vern. *harra.*

F. B. I. II 446. Br. 223.

Fl. and young foliage April. The young leaves are usually fully developed by the end of April, and the characteristic pale green *harra* foliage is then very noticeable in these forests when the majority of other trees are bare.

This tree is commonly found on a yellow soil, which is believed to contain a good deal of iron and which may be found overlying trap, laterite, sandstone or even metamorphic rocks. Probably the most characteristic *harra* areas are the open, park-like "forests," which cover the extensive plateaus, on the trap hills of the Mandla district, in this Division. The trees stand a considerable distance apart and are of moderate height but with fine large crowns, fully developed on all sides, which in a good year bear a "bumper" crop of myrabolans. Fruit ripens October—December. The young immature fruit which first falls is said to be used in medicine.

(149) T. ARJUNA. Vern. *koha.*

F. B. I. II. 447. Br. 224.

Common by streams. In damp places never quite leafless, elsewhere leafless April-May. Fl. June.

(150) T. TOMENTOSA. Vern. { *saj.* / *maru (Gondi).* }

F. B. I. II. 447. Br. 225.

Flowers and young foliage in June.

Shows best growth on heavy soil, where it is often associated with *Anogeissus latifolia.* The wood is here scarcely used, although formerly it is said to have been esteemed for building, etc.

(151) ANOGEISSUS LATIFOLIA. Vern. { *arma* (Gondi). / *dhawa.* }

F. B. I. II. 450. Br. 227.

Young foliage May-June; old leaves dark red before being shed in February.

Best growth on heavy soil.

(152) A. SERICEA. Vern. *kardhahi.*

Br. *Indian Forester,* Vol. XXV. p. 287. *Fl.* and young foliage March-April; fruit May. Fairly common on the black soil and alluvial tracts in valleys, among the trap hills. Attains a considerable size, a tree measured by me, near the Narbada, having a girth of 11 ft. at chest height and a clean bole 25 ft. in height.

(153) QUISQUALIS, INDICA.

F. B. I. II. 459. Br. 220.

Common in gardens.

MYRTACEAE.

(154) PSIDIUM GUAVA. Vern. *bihi*.
F. B. I. II. 468. Br. 232.
Widely cultivated.

(155) EUGENIA JAMBOLANA. Vern. *jāmun*.
F. B. I. II. 499. Br. 233.
Fl. March-April, and leaves renewed at the same time.
Fruit rains.

(156) E. HEYNEANA. Vern. *jamnera*, *kat jamun*, *halka jamun*.
F. B. I. II. 500.
Young foliage March-April.
Fl. April-May.
Common along water-courses and on river banks, where it is gregarious.

(157) CAREYA ARBOREA. Vern. *kumhi*.
F. B. I. II. 511. Br. 236.
Fl. and young foliage March-April. Young leaves at first purple.

LYTHRACEÆ.

(158) WOODFORDIA FLORIBUNDA. Vern. *dhawai*, *surteli* (Gondi).
F. B. I. II. 572. Br. 238.
Flowers March; used for dyeing.

(159) LAWSONIA ALBA. Vern. *mendhi*.
F. B. I. II. 573. Br. 238.
Commonly planted in hedges.

(160) LAGERSTRŒMIA PARVIFLORA. Vern. *lenria*, *seji*.
F. B. I. II. 575. Br. 239.
Fl. and young foliage April-June. Fruit ripens cold season and remains on the tree, sometimes as late as April. Is not eaten by cattle. Best growth on slopes and is very common on laterite. Coppices well; shoots 6 ft. in height were measured on the 13th June 1901 from stools cut on the 3rd March 1901.

(161) L. INDICA.—
F. B. I. II. 575. Br. 240.
Common in gardens, with pink, white and purple flowers.

(162) PUNICA GRANATUM. Vern. *anār*.
F. B. I. II. 581. Br. 241.
Cultivated in gardens.

CUCURBITACEÆ.

(163) MOMORDICA CHARANTIA. Vern. *karela*.
F. B. I. II. 616.
A common climber cultivated in villages.

SAMYDACEÆ.

(164) CASEARIA TOMENTOSA. Vern. *bheri.* *banbheri.* *tunrni.*

F. B. I. II. 593. Br. 243.

Fl. February-March. Fruit ripens May.

(165) C. GRAVEOLENS. Vern. *girchi.*

F. B. I. II. 592. Br. 243.

An elegant small tree with somewhat pendulous branchlets.

PASSIFLOREÆ.

(166) CARICA PAPAYA. Vern. *papaya.*

F. B. I. II. 599. Br. 244.

Cultivated in gardens. Fruit ripens April.

CACTEÆ.

(167) OPUNTIA DILLENII. Vern. *nāgphani.* *sanph phani.*

F. B. I. II 657. Br. 245.

Common in hedges and near villages. Run wild.

CORNACEÆ.

(168) ALANGIUM LAMARCKII. Vern. *ukol.*

F. B. I. II. 741., Br. 250.

Flowers April, when leafless.

RUBIACEÆ.

(169) ANTHOCEPHALUS CADAMBA. Vern. *kadam.*

F. B. I. III. 23. Br. 261.

Planted near villages and in avenues.

(170) STEPHEGYNE PARVIFOLIA. Vern. *kaim.* *keim.* *mundi* (Gondi).

F. B. I. III. 25. Br. 262.

(171) ADINA CORDIFOLIA. Vern. *haldu.* *kaim.* *keim.* Gondi.

F. B. I. III. 24. Br. 263.

(172) HYMENODICTYON EXCELSUM. Vern. *bihkaruk.* *mahuwa kārar.*

F. B. I. III. 35. Br. 267.

Fruit cold season; remaining long on the tree. Leaves turning yellow before being shed in December.

(173) WENDLANDIA EXSERTA. Vern. *tilban.* *telen.* *telman.*

F. B. I. III. 37. Br. 268.

Fl. March.

Common on broken ground near watercourses.

(174) GARDENIA TURGIDA. Vern. *karhār.*
F. B. I. III. 118. Br. 270.

(175) G. LATIFOLIA. Vern. { *pāphar.* / *pāpra.* / *paniabilo* (Gondi).
F. B. I. III. 116. Br. 271.
Flower and young foliage June.

(176) RANDIA ULIGINOSA. Vern. { *bhirāra.* / *katūl.*
F. B. I. III. 110. Br. 273.
Common in *sal* forests.

(177) R. DUMETORUM. Vern. *mainhar.*
F. B. I. III. 110. Br. 273.
Flowers June. Common in *sal* forests.

(178) IXORA PARVIFLORA. Vern. *kau.*
F. B. I. III. 142. Br. 275.
Fl. March-April; sweet scented; fruit ripens May.

(179) HAMILTONIA SUAVEOLENS. Vern. *bhowarmāl.*
F. B. I. III. 197. Br. 278.
Flowers November-December; common in dry places, especially on trap.

COMPOSITÆ.

(180) VERNONIA ROXBURGHII.
F. B. I. III. 232.
Undershrub; common in *sal* forests.

(181) V. DIVERGENS. Vern. *mohti.*
F. B. I. III. 234.
Common undershrub of shady forests, the long drooping leaves turning purplish-red before being shed. Gregarious.

(182) BLUMEA JACQUEMONTII.
F. B. I. III. 265.
Coarse shrubby herb. Fl. February.

(183) VICOA AURICULATA.
F. B. I. III. 297.
Herbaceous weed of waste places. Fl. February.

(184) GONIOCAULON GLABRUM.
F. B. I. III. 377.
Large herbaceous weed of waste places. Fl. February.

PLUMBAGINEÆ.

(185) PLUMBAGO ZEYLANICA.
F. B. I. III. 480.
Undershrub of shady forests. Fl. February.

MYRSINEAE.

(186) EMBELIA ROBUSTA. Vern. { *baibarang.* / *baibirangan.* / *dulduli.* }

F. B. I. III. 515. Br. 284.

Fruit cold season.

SAPOTACEÆ.

(187) BASSIA LATIFOLIA. Vern. { *mahaua.* / *iru* (Gondi). }

F. B. I. III. 544. Br. 289.

Fl. March-April. The young crimson-coloured leaves appear towards the end of April. In the north of the area there are considerable tracts, included in village lands, where the scattered *mahua* trees, with their magnificent crowns, remind one strongly of the oaks in an English park. The flower is of course a valuable commercial asset, and there are many open areas, included in the forests of this Division, which, if devoted to the formation of the *mahua* and *harra* "parks," which are so often met with in village lands outside the Reserves, would eventually prove the most valuable areas in the forests. The reproach, which is sometimes brought against the Forest Department, of keeping good cultivable soil within the Reserves without making use of it, or obtaining any considerable revenue from it, would then also be impossible.

(188) MIMUSOPS HEXANDRA. Vern. *khirni.*

F. B. I. III. 549. Br. 291.

Wild, but not common near watercourses. Cultivated.

(189) M. ELENGI Vern. *bho sari.*

F. B. I. III, 548. Br. 293.

Cultivated in gardens.

EBENACEÆ.

(190) DIOSPYROS TOMENTOSA. Vern. *tendu* / *tumri* (Gondi).

F. B. I. III, 564. Br. 294.

Young foliage April-May.

(191) D. MONTANA Vern. } *Patwan* / *patoh.* }

F. B. I. III. 555. Br. 296.

Fl. April.

OLEACEÆ.

(192) SCHREBERA SWIETENIOIDES. Vern. *ghānto* / *mokha.*

F. B. I. III. 604. Br. 305.

Fl. and young foliage May-June.

(193) JASMINUM ARBORESCENS. Vern. *chambeli.*
F. B. I. III. 594. Br. 311.
A climber or erect shrub. Common.

(194) J. PUBESCENS.
F. B. I. III. 592.
Cultivated in gardens.

(195) J. GRANDIFLORUM.
F. B. I. III. 603.
Cultivated.

(196) NYCTANTHES ARBOR-TRISTIS. Vern. { *sihāru.* / *khirsāri* (Gondi).
F. B. I. III. 603., Br. 314.
Young foliage June.
Common on laterite and coppices vigorously.

APOCYNACEÆ.

(197) CARISA CARANDAS. Vern. *rai karonda.*
F. B. I. III. 630. Br. 320.
Cultivated near villages. The flowers are sweet-scented and come out in March. Believed to be a cultivated form of the next species.

(198) C. SPINARUM. Vern. *karonda.*
F. B. I. III.; 631. Br. 321.
Exceedingly common, especially in the trap country and on black soil; the fresh green of the young leaves and the white star-like, strong-scented flowers which appear in the beginning of the hot season, in March-April, affording at this season a pleasant contrast to the black rocks, dark soil, and dried up red and yellow grasses which then characterize the trap region. Fruit ripens cold season; has a delicious flavour and makes excellent tarts and jelly.

(199) TABERNÆMONTANA CORONARIA.
F. B. I. III. 646. Br. 322.
Common in gardens.

(200) PLUMERIA ACUTIFOLIA. Vern. *champa.*
F. B. I. III. 641. Br. 323.
Common in gardens.

(201) WRIGHTIA TINCTORIA. Vern. { *dudhi.* / *bajardantu.*
F. B. I. III. 653. Br. 324.
Fl. and young foliage April. The follicles remain on the trees through cold season and ripen and dehisce on the trees in April. Old leaves shed January-February. The flowers and follicles of the local species agree with those of *W. tinctoria*, but the leaves are soft tomentose and resemble those of *W. tomentosa.*

(202) HOLARRHENA ANTIDYSENTERICA, Vern. *dudhi.*
F. B. I. III. 644. Br. 326
Sweet-scented white flowers in May. Young foliage April-May. Fruit remains on trees through cold season

(203) TERNOCARPUS FRUTESCENS. Vern. { *dimarbol.* *kauwārori.*
F. B. I. III. 669. Br. 327.
Fl. cold season; fruit February.

(204) NERIUM ODORUM. Vern. *kaner.*
F. B. I. III. 655. Br. 328.
Cultivated; with pink and white flowers.

(205) THEVETIA NERIIFOLIA. Vern. *kaner.*
Commonly cultivated.

(206) ALLAMANDA CATHARTICA.
Common in gardens.

(207) VINCA ROSEA. *var. albiflora.*
Common in gardens.

ASCLEPIADEAE.

(208) CRYPTOLEPIS BUCHANANI. Vern. { *dudhi.* *kauwārori.* *badisar?*
F. B. I. IV. 5. Br. 330.
Fruit cold season.

(209) CALOTROPIS GIGANTEA. Vern. { *akauā.* *akauwā.*
F. B. I. IV. 17. Br. 331.
Fresh flowers have a faint peculiar odour. Flowers purplish and occasionally white. Root of white variety used as a remedy for snake bite.

(210) C. PROCERA. Vern. { *akauā.* *akauwā.*
F. B. I. IV. 18. Br. 331.

(211) MARSDENIA TENACISSIMA.—
F. B. I. IV. 35. Br. 333.
Fl. rains.

(212) DAEMIA EXTENSA. Vern. *dudhi.*
F. B. I. IV. 20.
Fl. December, fruit February. In hedges near villages.

(213) HEMIDESMUS INDICUS.—
F. B. I. IV. 5.
Fl. September. Fruit cold season.

LOGANIACEÆ.

(214) STRYCHNOS POTATORUM. *Vern. khaia.*
F. B. I. IV. 90. Br. 317.
In *sal* forests; not common.

(215) BUDDLEI ASIATICA. Vern. *chachera?*
F. B. I. IV. 83. Br. 318.
On banks of nalas and rivers. Fl. January-February.

BORAGINEÆ.

(216) CORDIA MYXA. Vern. *rasalla.*
F. B. I. IV. 136. Br. 336.
Not wild; planted in avenues and near villages. Fruit ripens June.

(217) C. MACLEODII. Vern. *dahgan.*
F. B. I. IV. 139 Br. 337.
Fl. March-April. Fruit ripens May-June. Coppices vigorously. I measured shoots 10 ft. in height on the 13th June 1901 from stools cut on the 3rd March 1901.

(218) EHRETIA LÆVIS.—
F. B. I. IV. 141. Br. 340.
Old leaves shed January-February. Fl. January-Feburary. Young foliage April. Fruit ripens April-May.

(219) E. LAEVIS VAR FLORIBUNDA.—
F. B. I. IV. 141. Br. 340.
Fl. February-March.

(220) RHABDIA LYCIOIDES.—
F. B. I. IV. 145. Br. 341.
Common in river beds. Fl. February.

(221) CYNOGLOSSUM LANCEOLATUM.—
F. B. I. IV. 156.
Small hedgerow shrub.

(222) TRICHODESMA ZEYLANICUM.—
F. B. I. IV. 154.
Coarse, tall herb.

CONVOLVULACEÆ.

(223) LETTSOMIA SETOSA.—
F. B. I. IV. 194. Br. 344.
Fl. November-December.

(224) ARGYREIA SPECIOSA.—
F. B. I. IV. 185. Br. 343.
Common in gardens.

(225) PORANA PANICULATA. Vern. *senga.*
F. B. I. IV. 222. Br. 342.
Fl. November-December.

(226) CUSCUTA REFLEXA. Vern. *amarbel.*
F. B. I. IV. 225.
Fl. December-January.

(227) IPOMAEA TURPETHUM.—
F. B. I. IV. 212.

(228) I. QUAMOCLIT.—
F. B. I. IV. 199.
Cultivated in gardens and near villages. Very handsome with its red flowers and dark-green narrow linear leaflets.

(229) I. HEDERACEA.—
F. B. I. IV. 199.
Commonly cultivated in villages.

(230) I. COCCINEA.—
F. B. I. IV. 199.
Commonly cultivated in villeges; with showy dark-red flowers.

(231) I. SEPIARIA.—
F. B. I. IV. 209.
In hedges; white flowers, December.

(232) I. BONA-NOX. The Moon Flower.
F. B. I. IV. 197.
In gardens.

(233) RIVEA HYPOCRATERIFORMIS.
F. B. I. IV. 184.

(234) CONVOLVULUS ARVENSIS.—
F. B. I. IV. 219.
Common in fields.

SOLANACEÆ.

(235) DATURA FASTUOSA. Vern. *datura.*
F. B. I. IV. 242.
Fl. red; waste places near villages.

(236) D. STRAMONIUM. Vern. *datura.*
F. B. I, IV. 242.
Fl. white. Waste places near villages.

(237) SOLANUM XANTHOCARPUM. Vern. *badkoia.*
F. B. I. IV. 236.
Common straggling weed.

(238) S. MELONGENA. Vern. {*banbhata.* / *badkatiya.*}
F. B. I. IV. 235.
In waste places near villages, probably as an escape. Fruit globose yellow.

(239) WITHANIA SOMNIFERA.
F. B. I. IV. 239.
Small hedgerow shrub.
Fl. March.

SCROPHULARINEÆ.

(240) CELSIA COROMANDELIANA.
F. B. I. IV. 251.
Stout, herbaceous plant of hedgerows. Yellow flowers February.

BIGNONIACEÆ.

(241) MILLINGTONIA HORTENSIS.
F. B. I, IV. 377. Br. 347.
Common in gardens and avenues. Fl. end of rains. Does not here form fruit; young foliage April-May.

(242) STEREOSPERMUM XYLOCARPUM. Vern. { *pāral.* *bhainspāral.*
F. B. I. IV. 383. Br. 349.
Common in trap area.
Fl. April-May.

(243) STEREOSPERMUM SUAVEOLENS Vern. { *pāral.* *pāndri.* *jaimangal.*
F. B. I. IV 382. Br. 351.
Fl. April-May; young foliage appears at same time. Fruit remains on tree through cold season and ripens April.
Common in *sal* forest, but also found in teak area on trap.

(244) DOLICHANDRONE FALCATA. Vern. { *dudga.* *mersing.*
F. B. I. IV. 380. Br. 350.
Flowers April-May; young foliage at same time. Fruit cold season.

(245) OROXYLUM INDICUM. Vern. { *sumpāral.* *sona.*
F. B. I. IV. 378. Br. 347.
Planted near villages, in north of area, by Basores, who use the seeds for making hats and umbrellas. Fruit ripens January-March.

(246) BIGNONIA VENUSTA.
Common in gardens.
Fl. March-April.

(247) TECOMA STANS.
Common in gardens.

PEDALINEÆ.

(248) SESAMUM INDICUM. Vern. *til.*
F. B. I. IV. 386.
Commonly cultivated.

ACANTHACEÆ.

(249) ADHATODA VASICA. Vern. *rusa.*
F. B. I. IV. 540.
Gregarious in waste places near villages, especially in shady localities.

(250) STROBILANTHES AURICULATUS.
F. B. I. IV. 453.
Fl. cold season.

(251) DAEDALACANTHUS PURPURASCENS.
F. B. I. IV. 420.
Undershrub of shady places.
Fl. cold season.

(252) PETALIDIUM BARLERIOIDES. Vern. { *bunbuni?* / *katsariya?* }
F. B. I. IV. 416.
Fl. January-February and hot season. Common in sandy places, often with *Vitex Negundo*. Bark exfoliating in long papery strips.

(253) BLEPHARIS BOERHAAVIÆFOLIA.
F. B. I. IV. 478.
Fl. February; small undershrub with weak scrambling stems.

(254) HYGROPHILA SPINOSA. Vern. *ūnt katāra.*
F. B. I. IV. 408.
Small, spinescent, undershrub, gregarious in damp ditches, near tanks and such places. Has handsome blue flowers and is greedily eaten by camels.

(255) BARLERIA CRISTATA.
F. B. I. IV. 488.
Small undershrub of shady forests.

(256) B. PRIONITIS.
F. B. I. IV. 482.
In shady places near villages.

(257) B. LUPULINA.
F. B. I. IV. 482.
In gardens.

VERBENACEÆ.

(258) TECTONA GRANDIS. Vern. { *sāgon.* / *teka* (Gondi). }
The teak tree.
F. B. I. IV. 570. Br. 354.
Young leaves appear end of May in damp places, but full foliage not developed until June-July.
Stools cut on the 3rd March 1901 had sent out coppice shoots 2 ft. in height by 13th June 1901, although the teak trees in the surrounding forests were still quite bare of leaves. Coppice shoots three years old and 18 ft. high have been measured locally.

(259) CLERODENDRON PHLOMOIDES. Vern. *khirni.*
F. B. I. IV. 590.
Small tree, occasionally met with near villages.

(260) C. INFORTUNATUM.
F. B. I. IV. 594. Br. 363.
Gregarious in shady places.
Fl. March.

(261) C. SERRATUM—
F. B. I. IV. 592. Br. 364.

(262) C. SIPHONANTHUS.
F. B. I. IV. 595. Br. 364.
Fairly common in hedges, in black cotton soil.

(263) HOLMSKIOLDEA SANGUINEA—
F. B. I. IV. 596.
Only found once; undoubtedly wild; cultivated near villages.

(264) GMELINA ARBOREA. Vern. { *khumer.* / *khursi.* }
F. B. I. IV. 581, IV. Br. 364.
Young foliage April-May.
Fl. March-April.
Fruit ripens May-June, and is eaten by Gonds.

(265) VITEX NEGUNDO. Vern. { *ningōri.* / *nengur.* }
F. B. I. IV. 583. Br. 369.
Young foliage March-April.

(266) PREMNA LATIFOLIA Var. MUCRONATA. Vern. *Kota khursi.*
F. B. I. IV. 578. Br. 366.
Fl. July. Fruit October-November. Leaves have a strong unpleasant smell and fresh-felled wood exudes a green-coloured sap. Common on trap.

(267) P. BARBATA. Vern. { *karandi.* / *kota khursi.* }
F. B. I. IV. 579. Br. 367.
Large shrub or small tree.
Fairly common in trap area.

(268) DURANTA PLUMIERI.
F. B. I. IV. 560.
(269) PETRAEA STAPELIA.
} Common in gardens.

(270) LANTANA CAMARA.
F. B. I. IV. 562.
Cultivated and run wild.

(271) STACHYTARPHETA INDICA—
F. B. I. IV. 564.
Small shrub in gardens.

LABIATAE.

(272) POGOSTEMON PLECTRANTHOIDES. Vern. { *kora.* / *banlengor.* }
F. B. I. IV. 632.
Fl. January-February. A gregarious shrub of shady places with a strong smell like that of black currants.

(273) LAVANDULA BURMANNI—
F. B. I. IV. 631.
Small undershrub of dry forests. Common on trap.

(274) ANISOMELES OVATA.
F. B. I. IV. 672—
Tall branching herbaceous plant, the tall stems with dry fruit heads and the old leaves, which have then become red, being a noticeable feature of the hedgerows in the cold season.

(275) LEONOTIS NEPETÆFOLIA—
F. B. I. IV. 691.
Coarse, herbaceous plant of waste places near villages. *Attaining* a height of 6 ft. and very noticeable with its globose heads of red flowers.

(276) SALVIA PLEBEIA—
F. B. I. IV. 655.
Small shrub of hedgerows.

(277) S. SPLENDENS.
Small shrub, common in gardens.

AMARANTACEÆ.

(278) AERUA LANATA.
F. B. I. IV. 728.

(279) AMARANTUS SPINOSUS.—
F. B. I. IV. 718.
Herbaceous plant of waste places, with hollow hard stems.

(280) ACHYRANTHES ASPERA—
F. B. I. IV. 730.
Tall coarse herbaceous plant, common weed.

NYCTAGINEÆ.

(281) BONGAINVILLEA GLABRA—
Common in gardens.

CHENOPODIACEÆ.

(282) BASELLA RUBRA.
F. B. I. V. 20.
Succulent, strong-smelling twiner.

PIPERACEÆ.

(283) PIPER BETLE. Vern. *pān*.
F. B. I. V. 85.
Commonly cultivated.

LAURINEÆ.

(284) LITSOEA SEBIFERA. Vern. *maida*.
F. B. I. V. 158, Br. 379. (*Tetranthera laurifolia.*)
Not common.

(285) L. SEBIFERA. Var. *glabraria*.
F. B. I. V. 159.

PROTEACEÆ.

(286) GREVILLEA ROBUSTA.
Cultivated.

LORANTHACEÆ.

(287) VISCUM ARTICULATUM. Vern. *bānda.*
F. B. I. V. 226. Br. 393.

(288) LORANTHUS LONGIFLORUS. Vern. *bānda.*
F. B. I. V. 214. Br. 397.
Fl. cold season.

EUPHORBIACEÆ.

(289) EUPHORBIA NIVULIA. Vern. *thuhar.*
F. B. I. V. 255. Br. 439.
Branches without ribs. Wild in dry rocky places, common on Vindhyan sandstone.

(290) E. NERIIFOLIA. Vern. *thuhar.*
F. B. I. V. 255. Br. 439.
Branches ribbed. Planted in fences.

(291) E. TIRUCALLI. Vern. *thuhar.*
F. B. I. V. 254. Br. 439.
Run wild near villages.

(292) E. PULCHERRIMA. (Poinsettia)—
Br. 439.
Common in gardens.

(293) E. HETEROPHYLLA.
Common in gardens.

(294) JATROPHA CURCAS. Vern. { *chandarjot.* / *baranda.* }
F. B. I. V. 383., Br. 442.
Common in village fences.

(295) MALLOTUS PHILIPPINENSIS. Vern. *rora.*
F. B. I. V. 442. Br. 444.
In damp places, near nalas and streams.

(296) HOMONOIA RIPARIA. Vern. *surra.*
F. B. I. V. 455. Br. 445.
In rocky river beds.

(297) RICINUS COMMUNIS. Vern. *arand.*
F. B. I. V. 457. Br. 445.
Commonly cultivated.

(298) ANTIDESMA DIANDRUM. Vern. { *khatua.* / *amta* (Gondi). }
F. B. I. V. 361. Br. 447.

(299) BRIDELIA RETUSA. Vern. *kasai.*
F. B. I. V. 268. Br. 449.

(300) GLOCHIDION VELUTINUM.—
F. B. I. V. 322. Br. 452 (*Phyllanthus nepalensis*).
Small tree; fl. April.

(301) PHYLLANTHUS RETICULATUS. Vern. *mukhru.*
F. B. I. V. 288. Br. 453.
Large shrub, in hedges in open country. Fl. February-March. Twigs used as tooth-brushes.

(302) P. EMBLICA. Vern. { *aunla.* *aunra.* *nalli* *lalli.* } (Gondi).
F. B. I. V. 289., Br. 454.
Fl. and young foliage April.

(303) FLUEGGEA MICROCARPA. Vern. { *sirkin.* *chirechar.* *chiregori.*
F. B. I. V. 328. Br. 455 (*Securinega obovata*).

304) BALIOSPERMUM AXILLARE. Vern. *hansia dafar.*
F. B. I. V. 461.
Small shrub of waste places; stems a remedy for toothache.

(305) PEDILANTHUS TITHYMALOIDES. Vern. { *nāgphani.* *nāgdaman.*
F. B. I. V. 239.
Succulent shrub, planted in hedges.

(306) CHROZOPHORA PLICATA.
F. B. I. V. 409.

(307) ACALYPHA MARGINATA.
Common in gardens.

URTICACEÆ.

(308) MORUS LAEVIGATA. Vern. *tūt.*
F. B. I. V. 492 Br. 409.
Commonly cultivated for its fruit.

(309) FICUS BENGALENSIS. Vern. *bar.*
F. B. I. V. 499 Br. 412.
Young foliage April.

(310) F. TOMENTOSA. Vern. *chitākar.*
F. B. I. V. 501. Br. 414.

(311) F. INFECTORIA. Vern. *pākar.*
F. B. I. V. 515. Br. 414.
Receptacles are shortly peduncled.

(312) F. RELIGIOSA. Vern. { *pipal.* *āli* (Gondi).
F. B. I. V. 513. Br. 415.
Young foliage April. Fruit cold season and again February-March.

(313) F. PALMATA.
F. B. I. V. 530 Br. 419 (*Ficus virgata*).

(314) F. CARICA. Vern. *anjīr.*
Br. 418.
Cultivated in gardens.

(315) F. GLOMERATA. Vern. { *ūmar.* *gūlar.* *toiya* (Gondi).
F. B. I. V. 535., Br. 422.

Common near streams.
Young foliage April.

(316) F. HISPIDA, Vern. *kat-ūmar.*
F. B. I. V. 522. Br. 423.
Usually a shrub, rarely a small tree.

(317) F. GIBBOSA. Vern. *majni.*
F. B. I. V. 496. Br. 420. (*Ficus parasitica.*)

(318) F. SCANDENS. Vern. *pākar.*
F. B. I. V. 526. Br. 421.
In general appearance very like a small *F. infectoria*, and the vernacular name is consequently the same for both species.

(319) ARTOCARPUS INTEGRIFOLIA. Vern. *kathār.*
F. B. I. V. 541. Br. 425.
Cultivated.

(320) A. LAKOOCHA. Vern. *barhār.*
F. B. I. V. 543. Br. 426
Cultivated.

(321) TREMA POLITORIA. Vern. { *andia.* *majni.* *jilmili?* }
F. B. I. V. 484. Br. 430 (*Sponia politoria*).
Fl. July. Fruit cold season. Comes up rapidly on freshly broken ground, in the forest, *e.g.* on road embankments, sides of cuttings, etc.

(322) T. ORIENTALIS. Vern. { *andia.* *kūrsa.* }
F. B. I. V. 484. Br. 430 (*Sponia orientalis*).
Not common.

(323) HOLOPTELA INTEGRIFOLIA. Vern. *chirhōl.*
F. B. I. V. 481. Br. 431. (*Ulmus integrifolia.*)
Fl. February. Fruit March-April.

(324) CELTIS TETRANDRA.—
F. B. I. 482. Br. 429.
Fairly common on the banks of streams in the trap country. Flowers and young foliage appear February-March, at which season the beautiful rich green of the young leaves makes this species very noticeable.

(325) STREBLUS ASPER. Vern. *majni.*
F. B. I. V. 489. Br. 410.

(326) CANNABIS SATIVA. Vern. *bhang.*
The hemp.
F. B. I. V. 487.
Cultivated.

CASUARINEÆ.

(327 CASUARINA EQUISETIFOLIA. Vern. *surra.*
F. B. I. V. 598. Br. 435.
Cultivated in gardens.
Fl, February-March.

SALICINEÆ.

(328) SALIX TETRASPERMA. Vern. *bainsa.*
F. B. I. V. 626. Br. 462.
Locally gregarious along rivers.

CONIFERÆ.

(329) THUJA ORIENTALIS.
F. B. I. V. 644 Br. 534.
In gardens.

SCITAMINEÆ.

(330) CURCUMA LONGA. Vern. *haldi.*
F. B. I. VI. 214.
Cultivated.

(331) MUSA SAPIENTUM. Vern. *kela.*
F. B. I. VI. 262.
Cultivated.

AMARYLLIDEÆ.

(332) AGAVE AMERICANA.
F. B. I. VI. 277.
Cultivated in fences.

DIOSCOREACEÆ.

(333) DIOSCOREA SATIVA. Vern. *agita.*
F. B. I. VI. 295.
Fl. rains, and in foliage only at this season; dry fruit remaining on plant during cold season.

(334) D. PENTAPHYLLA. Vern. *baichandi.*
F. B. I. VI. 289.
In leaf and flower during rains.

LILIACEÆ.

(335) GLORIOSA SUPERBA.
F. B. I. VI. 358.
Fairly common. The beautiful red and golden flowers in rains.

(336) ASPARAGUS RACEMOSUS. Vern. *sataor.*
F. B. I. VI. 316.

(337) SMILAX MACROPHYLLA. Vern. *rāmdatūn.*
F. B. I. VI. 310.
Common; stems are used as tooth-brushes.

PALMEÆ.

(338) BORASSUS FLABELLIFER. Vern. *tār.*
F. B. I. VI. 482. Br. 544.
Occasionally cultivated.

(339) ARECA CATECHU. Vern. *supāri.*
F. B. I. VI. 405. Br. 551.
Occasionally cultivated.

(340) CARYOTA URENS.
F. B. I. VI. 422.
Occasionally cultivated.

(341) PHŒNIX SYLVESTRIS. Vern. *khajūri.*
F. B. I. VI 425 Br. 554
Widely cultivated and in places run wild.

(342) P ACAULIS Vern. *chind.*
F. B. I. VI 426. Br. 555.
Fl. April. The tender white peduncle is pulled out of the ground and eaten. It has a sweet taste. The tufts of handsome, broad, linear, lanceolate entire leaves often borne by this plant are very characteristic.
There are two forms locally recognised, *viz.*, (1) *kucha chind* with a large bulbous rootstock used as a brush for polishing metal ornaments, and (2) *bara chind* with no bulbous rootstock. The leaves of (1) are more rigid than of (2). As yet I have not been able to get complete specimens of both forms, but hope to do so.

PANDANEÆ.

(343) PANDANUS FASCICULARIS. Vern. *keora.*
F. B. I. VI. 485.
Fl. rains.

GRAMINEÆ.

(344) BAMBUSA ARUNDINACEA. Vern. *kattang bāns.*
F. B. I. VII. 395. Br. 564.
Cultivated; not wild in this area.

(345) DENDROCALAMUS STRICTUS. Vern. *bāns.* / *uhadur.* / *waddur.* } Gondi.
F. B. I. VII. 404. Br. 569.
Young leaves April-May.

(346) SACCHARUM OFFICINARUM Vern. *ganna.*
F. B. I. VII. 118.
Cultivated.

II.—CORRESPONDENCE.

An Experiment in Felling and Logging.

On looking up an old diary of two years ago I find the details of an experiment in tree felling which I made whilst on the hill section of the Assam-Bengal Railway. The experiment was made for my own purposes, but I think the results may prove of interest to some Forest Officers, and I therefore send you details of the experiment.

In connection with my work on the Railway I was doing a large amount of timber felling and conversion for bridge timbers, sleepers, and woodwork for the construction of stations, quarters, etc. Amongst a very large and mixed labour force working on the Railway I had Nepalese, Punjabi and Bengali (Sylheti) sawyers. These latter men could not be induced to enter the jungle and convert the trees on the spot, but would only work when the logs were drawn out into depots near the line. The experiment of which I write was the felling and dividing into logs of the tree known as nagesar (*Mesua ferrea*), one of the hardest woods known. I had no difficulty in selecting a number of trees growing within a comparatively small space and averaging about 45 feet in the bole, though some were a good deal longer. The men to be employed on the work were divided into pairs, as follows:--

1st pair, Punjabi Sikhs of the Tarkhan class.

2nd pair, Punjabis, one Sikh and one Mussalman, both of the Tarkhan class.

3rd pair, Kukis (one of the jungle Hill tribes of Assam).

The trees were selected and measured carefully by myself, and the time taken from the first stroke of the axe until the bole of the tree touched the ground. The date was the 9th October 1902.

Men employed.	Implements used.	Girth of tree at 5′ from *ground*.	Time taken to fell tree.	Number of logs convert-*ed*.	Time taken to log.
1st pair (Punjabi Sikhs).	Axe and saw.	6′ 6″	A.M. A.M. 9-5 to 10	3 in 3 cuts.	A.M. P.M. 10 to 12.
2nd pair (Punjabi Sikh and Mussalman).	Do. ...	5′ 10″	9 10 to 9-50	4 in 4 cuts.	9-50 to 12-20
3rd pair (Kukis).	Cutting axes only.	6′	9-5 to 10	2 in 2 cuts.	10 to 12-30

A second tree was felled by each pair between 1 and 3 p. m., one log only being cut by each pair from the thick end of the tree within this period. The first pair were given a tree of 7″ 10″ girth, the other two pairs one of 6′ girth apiece.

The first pair of men used axes of Punjabi pattern, and also made considerable use of the Punjabi hand saw in both felling and cross-cutting, but most of the latter was done with an M-toothed double-handed cross-cut saw.

The second pair used American felling axes, and did not make much use of the saw in felling. They also used an M-toothed saw in cross-cutting.

The third pair used their own axes (very narrow in the blade and light) for felling and also for logging the tree, as they were unable to use the saw, never having worked with it.

The men were of course worked under pressure, as I had offered a substantial prize to the best pair. This prize was awarded to the second pair.

JOGRAON, PUNJAB.
2nd October 1904.

M. H. LOGAN,
Resident Engineer,
Southern Punjab Railway Extension.

The Distribution of Seed.

The following extract, paragraphs 65—67, from the report of the Director, Department of Land Records and Agriculture, United Provinces of Agra and Oudh, for the year 1901-02, *is of considerable interest:—*

The work of the department falls into two divisions: cash sale of seeds at Cawnpore, the issues including such foreign staples are are asked for, as well as the best local varieties; and issue of seeds on loan to cultivators from various depots. From Cawnpore 89 kinds of seed were issued, about 336 maunds in all being disposed of. The varieties most in demand were Muzaffarnagar wheat, Cape oats, and Jaunpur maize. The demand for Canadian oats, acclimatised cotton, *inga dulcis*, peas and rape was in excess of the available supply.

Seed depôts were at work during the year in Partabgarh, Aligarh, Meerut, Mohanlalganj, Beti, Sultanpur and Amethi. The first three are managed and financed directly by the Department: those at Mohanlalganj and Beti are managed by the Court of Wards with departmental assistance: those at Sultanpur and Amethi are managed by the department but financed by the district board. In addition to these centres, operations have started in Fyzabad, where the Deputy Commissioner has devoted some funds at credit of the agricultural show to the same purpose.

The scheme of operations at those various centres is uniform: clean, sound seed is issued to cultivators, who return the produce at harvest time *plus* 25 *per cent*. The receipts are carefully cleaned and picked, all inferior seed being sold and the balance kept for issue in the next year. When operations started in Partabgarh I tried to work through the landholders, but their interest in the matter was short lived, and direct dealing with the cultivators is proving far more satisfactory. The work done during the year may be summarised as follows. The issues from the depots controlled by the Department were 756 maunds, of which 534 maunds were Muzaffarnager wheat. The Mohanlalganj depot issued 217 maunds, consisting of wheat and oats, and that at Beti 621 maunds, mostly wheat. The depots at Sultanpur and Amethi issued 444 maunds of wheat and a small quantity of maize. The total issues thus amounted to over two thousand

maunds. There was practically no loss in recovery, and issues for the current rabi are on a considerably increased scale, while arrangements are being made to procure stocks of kharif seeds for which a demand has arisen. The work is carried on at small profit, which is devoted to extending operations: it does not at present admit of reducing the rate of interest. The keenest desire for seed continues to be manifested in the neighbourhood of Amethi, where the cultivators crowded to the railway station to await the arrival of the imported seed; but in other localities also the services of the Department are cordially welcomed.

The Timbers of Commerce.

By Herbert Stone, F. L. S., F. R. C. I.

The material for this book was collected by the author, not with a view to publication, but as necessity arose during the conduct of a business in which many different kinds of woods were used and much difficulty was often experienced in distinguishing one wood from another.

The book describes all woods met with on the British market and many others which have been sent from the Colonies as being useful and abundant and likely some day to be of commercial importance. The number of timbers described is 247 and each genus in the descriptive part of the book is represented by a photo-micrograph. These photo-micrographs, of which the book contains over 180, are really excellent and are designed to show the appearance of a transverse section of the wood as seen through an ordinary hand lens magnifying to about three times the actual size. The impressions are beautifully distinct and are capable in many instances of giving, apart from the letterpress, a safe clue to the identification of the wood.

The description given of each wood comprises the natural order, the synonyms and alternative names, the source of supply, the physical characters, uses, colour and the anatomical characters on transverse, radial and tangential sections.

Were all this information correct the book would serve its purpose and be of the greatest use to those who have to handle various sorts of foreign timbers. A cursory perusal of the descriptions of some of the Indian woods, however, has given rise to very grave doubts as to whether many of the descriptions are sufficiently correct to be of any use.

Perhaps the best known timber in Northern India is deodar, and yet Mr. Stone appears never to have come in contact with it, as the only allusion to deodar in the whole book is in the description of Tascus baccata, where mention is made that the Yew is called deodar in some parts of the Himalayas.

Again, Padouk is said to be Pterocarpus indicus with a synonym Pterocarpus dalbergioides. It has long been known that they are different species and the timbers have quite different properties and characteristics, so much so that the Ordnance Department will accept the one and not the other. The Padouk exported from the Andamans is P. dalbergioides, and this is the one which a person engaged in the home timber trade is most likely to come across.

Camwood or Barwood is said to be very similar to East Indian Sandal-wood. As Camwood is used as a dye-wood, is reddish-orange in colour and gives a claret-coloured solution, it cannot be very like Sandal-wood, although it may very closely resemble Red Sanders, which is Pterocarpus santalinus and not P. santalinoides.

Margosa or Margose, as it is called by Mr. Stone, is Melia indica, and quite a different tree from M. azadirachta. Even the description of teak is open to objection. Under physical characters it is said, "smell characteristic and powerful, like old shoe-leather, very offensive when being worked." Hardly a good description of the characteristic odour of teak. Anamalais teak is said to be known in the timber trade as "stinking teak," but this must be only a relic of former days, as Anamalais teak was all cut out long ago and probably not a single stick has reached Europe during the last quarter of a century.

These are only a few instances of the inaccuracy of some of the information given in a book which, had it been trustworthy, would have been as welcome as it was required.

V.—SHIKAR AND TRAVEL.

The Indian Pheasants and their Allies.

BY F. FINN, B.A., F. Z. S.

(Concluded)

CHAPTER X.

THE BUTTON- QUAILS AND MEGAPODE.

I have already, in the beginning of the last chapter, drawn attention to the fact that the Button-Quails or Hemipodes do not belong to the *Phasianidæ* at all, not being true quails, and have pointed out their external differences from the latter. To briefly summarise the most striking of these differences again, I may mention that the Indian Button-Quails have no hind toe, and have, in life, distinctly yellowish white eyes, which give them a very different expression. In general habits they resemble the true quails, but the males are always smaller than the females, and are altogether the inferior sex, sitting on the eggs and taking care of the young, while the hens are bold and

pugnacious, fighting like the males of the true quails, and not at all domestically inclined. The Button-Quails can hardly be seriously regarded as objects of sport, but they are good to eat, and probably useful in a humble way as insect-destroyers, as they can attack proportionately larger insects than the true quails, owing to their larger bills.

Three very distinct species are found with us, easily distinguishable by the colour of their legs; but one of these has two sub-species or local races, so that five are usually reckoned. All Button-Quails, it may be added, do well in confinement, most becoming very tame; they are all well worth taking home, as they are seldom procurable in Europe alive.

THE BLUE-LEGGED BUTTON-QUAIL.

Turnix, pugnax Blanford, Faun. Brit. Ind., Birds, Volume IV, p. 151. Native names:—*Gulu*, *Gandlu*, *Salui-gundru*. Hindi; *Koladu* (male), *Pured* (female). Telugu; *Aukádeh* (male), *Kurungkadeh* (female). Tamil; *Durwa*, Ratnagiri; *Káre-haki*, Kanarese in Mysore; *Timok*, Lepcha; *Ngon*, Burmese. This bird is often called the "Bustard-quail" in books, but the name is distinctly misleading, as this species is as unlike a bustard as are the rest.

The general colouring of the male of this species above is a complicated mixture of brown, black, and white, more reddish in some specimens than in others; below, it is buff, with a whitish throat and black bars across the breast. In the female the throat is black, and the middle of the breast black also to a greater or less extent. Young birds have black spots on the breast instead of bars.

The bill and legs in this species are blue-grey, which, with the barred breast, conspicuously distinguish it.

The cock is six inches long, with a wing of about three inches; the hen about half an inch longer, with a noticeably stronger bill. In captivity I have seen her eat, whole, butterflies two inches across.

This bird is found all over the Empire except in the higher parts of the hills and in Sind and the Punjab; it avoids deserts and heavy forest; out of India it ranges east to China and Formosa. It usually breeds in the rainy season, sometimes simply laying in a hollow, and sometimes making a domed nest. The eggs are usually four, greyish with reddish and brown markings, and nearly an inch long. The variation of colour in this bird follows the climate it inhabits, the darkest and greyest specimens coming from districts where there is a heavy rainfall; these individuals evidently having a constitution more suited for resisting damp. It is, of course, possible that a damp climate may have a direct effect on the plumage, but this could only be established by keeping the reddish specimens from a dry tract in an open-air aviary in a damp district, and observing if they moulted out greyer.

THE YELLOW-LEGGED BUTTON-QUAIL.

Turnix tanki, Blanford, Faun. Brit. Ind., Birds, Volume IV, p. 153.

Native names:—*Lowa*, *Lowa-butai*, Hindi; *Pedda dabagundlu*. This is about the same size as the last species, but is less speckled above and more inclined to a plain drab; moreover at certain seasons, the hens have a chestnut half-collar at the back of the neck. The underparts are buff without bars, but with black spots at the sides of the breast. Young birds are redder and more speckled above. The bill and legs are bright yellow, with a black streak along the ridge of the bill in males.

This bird is found all over India, including Sind, but does not usually range above 4,000 feet in the hills. In April 1898, however, Mr. Goldstein, the Chemist at the Chowrasta in Darjeeling, showed me a live specimen he had captured there under very peculiar circumstances: it was flying round and round a lamp where he used to catch moths, and he caught it in a butterfly-net.

Its breeding time is in July and August in Upper India, but in Mysore about April, and its eggs are of a similar type to those of the last species. Mr. D. Seth-Smith has bred it in England, and finds the incubation-period to be only twelve days, whereas the equally small Painted Quail takes three weeks. The hen Button-quail is so masculine in her character that during courtship she gives her mate any tit-bit she may obtain, just as the common cock and some others of the true game-birds do with their females! Moreover, she does not care at all for her young, but eats the food they ought to have.

It was Mr. Seth-Smith who found out that the chestnut collar of the female was merely her full dress, whereas students of skins had considered it a sign of age—a fact which shows the importance of the study of living birds, even if they have to be kept in captivity.

THE BURMESE YELLOW-LEGGED BUTTON-QUAIL.

Turnix blanfordi, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 156.

Native name:—*Ngon*, Burmese.

This is hardly a distinct species, but merely a large local race of the last one, the females being seven inches long as against the six and a half inches of the Indian specimens. The plumage, however, is distinguishable in adult specimens by the greater amount of black barring on the back. This species ranges from Assam and Chittagong to China; of course extending through Burma.

THE NICOBAR YELLOW-LEGGED BUTTON-QUAIL.

Turnix albiventris, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 154.

This is another local race of *Turnix tanki*, not exceeding it in size, but more mottled with black and reddish on the back in adults, and with the female's collar of a darker chestnut. It is confined to the Andamans and Nicobars, and rare in the former group of islands. "Species" like this and the last are really better distinguished by the American system of "trinomials" so as to stand as *Turnix tanki blanfordi*, and *T. tanki albiventris*. While it would hardly do to ignore them, I think it is rather absurd to give them full specific rank.

THE WHITE-LEGGED OR LITTLE BUTTON-QUAILS.

Turnix dussumieri, Blanford, *Faun. Brit. Ind., Birds*, Vol. IV, p. 152.

Native names:—*Ghinwa lowa*, *Chota lawa*, *Dabki*, *Tura Chimnaj* (in Muttra); *Libbia* (in Purneah). Hindi; *Darwi*, Ratnagiri; *Chinna* or *Tella dabba gundlu*, Telugu; *San gundlu*, Uriya.

This species is at once distinguished from the others by its smaller size and lighter colour, besides its funny little pointed tail, which is long enough to be noticeable, while those of our other Button-quails are not so any more than are those of the typical quails. Above it is mostly chestnut mixed with cream-colour, and nearly white below, running into buff on the breast, with black spots on the sides of the latter. Male and female are alike in colour, and the former is in this species not very much the smaller. The bill is blue-grey and the feet fleshy-white. At times I have seen birds of this species in the Calcutta market with blue-grey legs, but in the case of such specimens the characteristic points given above will afford a means of distinction from the blue-legged Button-quail. The hen is five-and-a-half inches long, with a wing of nearly three inches.

This bird inhabits most of India and Burma, but not Ceylon, nor does it seem to occur south of Mysore, nor does it range high up the hills. It extends eastward to Hainan and Formosa. Its breeding season is from April to October, and the eggs, laid in a hollow lined with grass, may sometimes be as many as six. They are stone-coloured with a fine brownish speckling and larger spots of darker brown, and measure about four-fifths of an inch in length. Few birds become so quickly tame in captivity as this funny little creature, which always has a curiously young appearance; in a few days it will allow itself to be touched, and seems quite at home in a cage if allowed plenty of sand to wallow in. Mr. Seth-Smith has had specimens, but did not succeed in breeding from them, possibly because they felt the English climate more than the yellow-legged species.

The last bird I shall have to notice is a much nearer ally to the pheasants than are the Button-quails belonging to the family of Mound-birds (*Megapodiidæ*), which are always

acknowledged to be near relatives of the *Phasianidæ*, differing chiefly in their long hind-toe and curious habit of burying their eggs, which disclose full-fledged young.

THE NICOBAR MEGAPODE OR MOUND-BIRD.

Megapodius nicobariensis, Blanford, Faun. Brit. Ind., Birds, Vol. IV, p. 147.

In general appearance this bird resembles a large dull-brown partridge, with very short tail and huge legs and feet, of which the hind-toe is large and set on at the same level as the other toes, as in a pigeon. The claws of all the toes are long, broad, and nearly straight. The wings, although of blunt and rounded form, are larger than is usual in partridges. The plumage is plain dull brown, redder above and greyer below, becoming quite grey on the head; there is none of the marking or pencilling usual in partridges. The cock and hen are alike; young ones have no grey tinge below. The skin round the eyes is bare and red. The bill is yellowish or greenish, and the legs horn-colour, becoming reddish at the back; the eyes are brown. The length is sixteen inches, the closed wing measuring nine and the tail three, while the shank is nearly three, and very strong.

This species is confined to the Nicobars, and is a very outlying member of its family, none being found nearer than the Philippines and Celebes, while most of them inhabit the Australian region. Its general habits are those of a jungle-fowl; it is found in pairs or flocks, does not fly unless pressed, and readily perches. It has a cackling note, and feeds both on small animal life and vegetable food, being itself most delicious to eat, according to Mr. Hume, who compares it to a fat turkey and pheasant.

The huge eggs, which are more than three inches long, and pink when new-laid, are buried by the birds in a mound of vegetable matter and sand, which they scratch up in the jungle close to the shore. There their responsibility ceases; the eggs hatch out by themselves in the mound, and the young come out of the egg fledged and able to fly, work their way to the upper air, and go off on their own account; they look not unlike dull-brown quails.

In 1900 four of these birds were presented to the Calcutta Zoological Garden by Colonel Anson, and lived there for some time. These were hatched from eggs which had been taken from a mound in the Nicobars and brought up to the Andamans without any attention at all, so that this species is hardy enough in the egg. The young birds were reared on white ants, and were very tame when they came to Calcutta. The species would be a very good one to acclimatize in any of our insular possessions boasting a warm climate, but I doubt if it could maintain itself on the mainland of India, where jackals and such ground vermin would devastate the mounds.

VI.—EXTRACTS, NOTES, AND QUERIES.

A Word For Forestry.

BY THE HON. GROVER CLEVELAND

Ex-President of the United States.

THE centennial celebration of our acquisition of the vast domain included in the Louisiana Purchase suggests certain topics which, though important to other localities and at all times, are peculiarly related to the Western section of our country, and are now more than ever demanding serious attention.

Those most proudly happy in their sanguine Americanism, and most confident of our ability to accomplish all things, must confess that our national life has been habitually beset with careless wastefulness, and that a palpable manifestation of this wastefulness is seen in the destruction of tree growth and the denudation of watersheds on our Western lands. Laws passed with the professed intent of protecting our forests have been so amiably construed as to admit of easy evasion, and their execution has too often been lax and perfunctory. In the meantime, public opinion on this subject, which might be as effective as legal enactment, has comfortably slumbered.

Even if we now abjectly repent of our sins of omission and commission in our treatment of the forests and streams which nature has given us, and reproach ourselves for the neglect of a trust imposed on us for the benefit of future generations, we must at the same time humbly confess that the punishment we have suffered by flood, by drought, by tornado, by fire, by barrenness of soil, and by loss of timber value, is well deserved.

In these circumstances it is exceedingly gratifying to have an appropriate opportunity to congratulate those who have constantly laboured in the cause of forestry and forest preservation, as well as those interested in the cognate subject of irrigation, upon the prospect that these topics are to have more prominent places in governmental care.

Through the teachings of intelligent forestry it has been made plain that in our Western localities ruinous floods and exhausting droughts can be largely prevented, and productive moisture in useful degree and at needed periods secured, by a reasonable and discriminating preservation of our forest areas; the advocates of irrigation have been led to realize that it is useless to provide for the storage of water unless the sources of its supply are protected; and all those who, in a disinterested way, have examined these questions concede that tree growth and natural soil on our watersheds are more valuable to the masses of our people than the footprints of sheep or cattle.

The opportune time has arrived when effective public interest in forestry and forest preservation should be persistently aroused and stimulated.—*The Century Magazine*, Western Number.

Where are the Largest Trees in the World?

By J. H. Maiden.

The record of abnormalities of size of plants, animals, and indeed of any objects, has always had a fascination for the human race. From "Far Cathay," and also from Africa, whence there emerged "always some new thing," travellers brought home extraordinary accounts of the plants they had seen. And, in order to stimulate the public appetite, the travellers whose peregrinations were probably, at the outside, confined to a few English counties, were quite willing, from their tenements in Grub-street, to vastly improve the reports of voyagers. And as sailors are proverbially given to "yarns," it is not surprising that tales in regard to vegetable productions became so extraordinary up to the eighteenth century, that finally no one would own them, and the places of their growth came to be stated with the most delightful vagueness.

A great many tales about Australian vegetation have, from time to time, become current, only to become demolished as the continent became better known. But there is one phase of the subject that is of real scientific interest—I allude to the size of our trees, and in regard to these we have still much to learn. It is very difficult for some people to understand that, in a question of this kind, only actual measurements, by tape or theodolite, or records by an observer of proved accuracy, can be admitted. The mere guessing of heights is rarely attended with even an approximation to accuracy. I have been given the most astounding heights for certain trees, and when I have asked for evidence I have sometimes given offence.

The kudos attaching to the ownership of the largest (highest) tree in the world is usually claimed for California and Australia. We will examine the evidence presently, and I think it will be seen that we know very little about the world's highest trees. It seems a pity that, years ago, before many of the giants were levelled for the necessities of civilisation, scientific measurements were not obtained. There are, however, even yet monarchs of the forest in regard to which these data should be collected.

The greatest claims for Australian trees have been made on behalf of Victoria, most of them from Gippsland. In 1862 Mueller wrote to Seemann's "*Journal of Botany*" that Mr. D. Boyle, of Nunawading, near Melbourne, had measured a fallen tree in the recesses of the Dandenong, and found it to be 420 feet. About the same time he wrote to the "Australasian" giving more details about this tree, which was stated to be 392 feet long. He added 30 feet as a fair estimate of the length of the top, which had broken off, and thus we have 420 feet as the height of this tree.

Henniker Heaton states that on the Blacks' Spur were two trees, one alive, measuring 420 feet in height, and the other

(prostrate) 480 feet high. He adds that Baron Mueller is the authority for those measurements. One version, therefore, states that the 420-feet tree is prostrate, and the other that it is alive. If these statements are correct, then two trees of this stupendous height are referred to. Following is another account of the 480-feet tree. A note by Mueller in the "Gardeners' Chronicle" for 1862 says that several trees had been recently measured at the Upper Yarra and on the Dandenong. He adds: "The highest known is ascertained to be 480 feet, and therefore as high as the Great Pyramid." The same writer, in Seemann's "Journal of Botany," says that it was a Mr. Klein who measured a tree on the *Blacks' Spur, 10 miles from Healesville, and found it to be* 480 feet high. Mueller, in his "Select Extra-Tropical Plants," states that a tree was measured in the Cape Otway Ranges 415 feet high and 15 feet in diameter. Another tree measured at the base of the stem 69 feet in circumference; at 12 eet from the ground 14 feet in diameter; at 78 feet 9 feet in diameter; at 144 feet 8 feet in diameter, and at 210 feet 5 feet. All these trees belong to the species described by Mueller as Eucalyptus regnans, on account of its crowning height. It is the tree known in Victoria variously as "white gum," "messmate," and "peppermint" (it varies much in the bark), and Mueller alludes to it as "the tallest tree of the globe, surpassing even the renowned California Sequoia and Wellington pines in height, reaching to 400 feet, and even more."

In 1889 the Hon. F. Stanley Dobson, of Melbourne, quoted Mueller as having stated in his "Botanic Teachings" that our gum trees attain a height of 500ft. I cannot trace this particular reference, but I have other *references* of such a height to which Mueller gave currency. For example, in Seemann's "Journal of Botany" he states that Mr. George W. Robinson, in the back ranges of Berwick, found a tree 81 ft. in girth 4ft from the ground, and supposes that towards the sources of the Yarra and Latrobe Rivers it attains 500ft.

But we have not reached high-water mark yet. Mr. David Boyle, who for 27 years had been identified with big trees, in 1889 wrote to the Melbourne "Argus" giving 525ft. as the height *of a tree known to him some years previously. As this was* considered to be rather "tall," and is, I believe, the greatest height in or out of Australia claimed for a tree. Mr. Boyle replied to inquirers: "I determined to have it photographed and measured, 10 years having elapsed since I measured it before . . . I found it. The tree was healthy, the only change in it since I saw it last being that a portion of the top was blown away. The measurement now is 465ft. high, and its circumference 4ft. from the ground 81ft.; base 114ft."

Visitors to the Melbourne International Exhibition of 1888 will remember the photographs of a large butted gum-tree by Mr. N. J. Caire, photographer, who stated that he had come across this

monster in Gippsland, and that its height was 464ft. He called it "The Baron," after von Mueller. Here was something very definite to go upon. The Trustees of the Public Library, Melbourne, voted £100, the Trustees of the Exhibition Building another £100, the Minister for Lands promised a sum not exceedding £800, to have this leviathan measured and photographed. After some hesitancy on the part of the photographer, the identical tree photograph was found. The Inspector of Forests and a Government Surveyor measured it accurately, and found it to be 219ft. 9in. Here was a come-down. "No tree in the neighbourhood reached 300ft." The tree, of which a specific measurement was given, was found, on actual measurement, to be less than half its reputed height. The Hon. James Munro, Premier of Victoria, thereupon offered a reward of £100 out of his own pocket for any Victorian tree 400ft. in height—and the reward has remained unclaimed to this day.

It turned out that Mr. Boyle's tree and Mr. Caire's were identical, so that the 525ft.-tree shrank over 300ft. The public interest aroused at the time brought a crop of other guesses and measurements.

Mr. Stanley Dobson, who spent much time trying to get at the truth in regard to these trees, writing to the Royal Society of Tasmania, "believed" that the highest found by a Government Surveyor was near Neerim, in Gippsland, and was 325ft. Even this was excessive, as the "Sydney Morning Herald" of January 21, 1889, gives the height as "227ft. with the top broken off, and a girth 6ft from the ground of 55ft. 7in." Another tree on the Blacks' Spur, at Fernshaw, had a height of 237ft. 6in., the top being broken off, the girth 6ft. from the ground being 50ft. A still loftier tree reported was that on Mount Monda with a height of 307ft., and a girth 6ft. from the ground of 22ft. 8in. The height given of a tree on Mount Baw Baw is 326ft. 1 in., with a girth 6ft. from the ground of 25ft 7 in.

Next to Victoria the largest Australian trees are claimed on behalf of Tasmania. In the first part of the letters of Quaker Missionary Backhouse there are some measurements of large stringybark trees (Eucalyptus obliqua) on the Emu River. I content myself with quoting three. The first was 45ft. in circumference, and the supposed height 180ft., the top broken. The second was 55ft. in circumference; supposed to be upwards of 200ft. high. He measured near Hampshire Hills two trees that had been felled for splitting into rails, each 180 ft. long.

In 1886 the late Mr. Perrin, then Conservator of Forests, Tasmania, reported that one fallen tree that he measured near Geeveston gave the following dimensions: 250 ft. to the first limb, 300ft. to the junction of three limbs forming the head of the tree, 309ft. to the broken stem, which here gave a diameter of over 2ft. The total height of the tree might fairly be placed at 330 ft. At 8 ft. from the ground the circumference was about

40ft. *It seems to me that it has not been proved that the* largest Victorian tree is larger than the largest Tasmanian ones.

Turning to Western *Australia*, Mueller, in Seemann's "Journal of Botany," states that Mr. Pemberton Walcott measured a karri (Eucalyptus diversicolor) in one of the delightful glens *of the Warren River, "where it rises to approximately 400ft."*

I do not reconcile these statements as to measurements and approximation. On another *occasion* "Messrs. Muir saw trees with stems 300ft. long up to the first branch, and I myself noticed many trees which approached to 440ft. in their total height. *When closely growing the young trees may have a comparatively* slender trunk, so much so that a tree 180ft high may show a stem hardly over a foot in diameter." These figures require verification.

Eucalyptus marginata, the Jarrah or mahogany of South-West *Australia, is a smaller tree, yet it is said to attain a height* of 200ft. (Brown in "Treatise on Tree Culture in South Australia") and a circumference of 32ft. (*Mueller*).

Some enormous figures are given for the blue gum of Victoria and Tasmania (Eucalyptus globulus), *viz.*, height 350ft. *(Mueller), 400ft. (Brown), and from 30 to 100 feet in circumference* (Brown). I doubt their correctness, and we should not be content with estimates.

The bunya bunya of Queensland (Araucaria bidwilli) is stated to grow up to 200ft. I do not know of a reliable record of a New *Zealand tree above the same height.*

Our own State has had some big trees, but, so far as I know, none so high as the *highest of Victoria and Tasmania.* "In the "Herald" of March 10, 1891, I gave the following figures (actual *measurements* of the Bulli big-tree (a blackbutt, Eucalyptus pilularis): *Girth at ground, measuring* from buttress to buttress, 57ft.; 6in : girth at 3ft. above the ground, 45ft.; and at 6ft., 40ft. The taper is thence very gradual for about 90ft. estimated), where the trunk is broken off, but some of its branches are of the size of small trees. In the "Agricultural Gazette" for 1895 I *gave measurements of some large* tallowwoods (Eucalyptus microcorys) felled for a sawmill at Coopernook.

Let us now briefly turn to large *non-Australian trees.* The baobab (Adansonia digitata) is found in tropical Africa, and we have an Australian species (A. Gregorii) in North-West Aus*tralia. Both are gouty-looking trees,* whose diameter is out of all proportion to their height. The height of the African tree is given at from 40ft. to 70ft., and its diameter at 30ft. The largest tree seen in Gregory's Northern Australian expedition was nearly as large, being 85ft. in girth at 2ft. from the ground.

As regards the American trees, I cannot do better than quote the monumental "Silva of North America," by Professor Sargent, which is a work of the highest value. He *says:* "The redwood (Sequoia sempervirens), which is the tallest American

tree, probably occasionally attains the height of 400ft. and more. The tallest specimen I have measured was 340ft. high." This is the timber so well known to us in New South Wales, being the best known tree of Pacific North America. Professor Sargent goes on to say: "Among American trees the redwood is exceeded in size only by Sequoia Wellingtonia." Here he differentiates between height and bulk.

Turning to Sequoia Wellingtonia, known in California as "Big Tree," Sargent says: "Its average height is about 275ft. and its trunk diameter near the ground 20ft., although individuals from 300ft. to 320ft. tall, with trunks from 25ft. to 35ft. thick, are not rare." Speaking of the celebrated Calaveras trees, he says: "In the Calaveras grove there are three trees over 300ft. high, the tallest measuring 325ft. The largest tree measured by Muir is standing in the King's River forest, and 4ft. above the ground has a diameter of 35ft. 8in. inside the bark."

He also states Sequoia Wellingtonia is the largest inhabitant of the American forests, and the most massive-stemmed, although not the tallest tree in the world. In this passage he is not merely indicating that the redwood is a taller tree, but I believe he is referring also to the Australian trees, which he, from reports, believes to be taller.

Professor Sargent is an eminent authority on the subject of which he treats, and in view of the actual measurements that he presents, *viz.*, 340ft. in height for a redwood and a girth round the trunk of 107ft. for its congener, the "Big Tree," I am of opinion that, so far as our knowledge goes at present, California is the home both of the tallest and of the broadest trees in the world.—*The Sydney Morning Herald.*